

THE
FOOD AND GAME FISHES
OF NEW YORK

BY
TARLETON H. BEAN

Chief, Department Fish and Game, World's Fair, St. Louis



ALBANY
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State of New York
Forest, Fish and Game Commission

The Food and Game Fishes of New York:

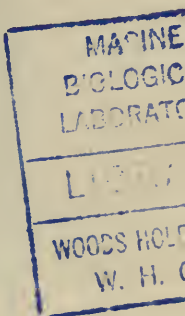
Notes on their Common Names, Distribution, Habits
and Mode of Capture

[With 9 Plates and 132 Text Figures]

By

Tarleton H. Bean, M. S., M. D.

Chief, Department of Fish and Game, World's Fair, St. Louis



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97. THE CRAPPIE.

Common Names of Fishes.

Num- ber.	Page.	Num- ber.	Page.
49. Anchovy, Mitchill's, . . .	311	148. Dab, sand, . . .	459
48. Anchovy, striped, . . .	310	128. Drum, . . .	433
98. Bass, calico, . . .	384	129. Drum, fresh-water, . . .	436
106. Bass, large mouth black, . . .	396	124. Drum, red, . . .	428
99. Bass, rock, . . .	386	36. Eel, . . .	292
114. Bass, sea, . . .	411	28. Fallfish, . . .	285
105. Bass, small mouth black, . . .	394	115. Flasher, . . .	414
112. Bass, striped, . . .	406	147. Flounder, four-spotted, . . .	458
111. Bass, white, . . .	405	146. Flounder, southern, . . .	457
130. Bergall, . . .	437	145. Flounder, summer, . . .	456
131. Blackfish, . . .	439	149. Flounder, winter, . . .	460
93. Bluefish, . . .	377	34. Goldfish, . . .	289
103. Blue-gill, . . .	390	138. Haddock, . . .	448
85. Bonito, . . .	368	140. Hake, . . .	451
17. Bullhead, black, . . .	276	141. Hake, squirrel, . . .	452
139. Burbot, . . .	449	143. Halibut, . . .	454
96. Butter Fish, . . .	381	95. Harvest Fish, . . .	381
35. Carp, . . .	290	44. Herring, branch, . . .	302
19. Carp, lake, . . .	277	45. Herring, glut, . . .	304
10. Catfish, channel, . . .	270	53. Herring, lake, . . .	317
11. Catfish, lake, . . .	271	41. Herring, sea, . . .	298
13. Catfish, long-jawed, . . .	273	32. Horned Chub, . . .	288
16. Catfish, marbled, . . .	276	29. Horned Dace, . . .	286
18. Catfish, stone, . . .	277	15. Horned Pout, . . .	274
14. Catfish, white, . . .	273	127. Kingfish, . . .	432
12. Catfish, yellow, . . .	272	88. Kingfish, Sierra, . . .	371
87. Cero, . . .	370	1. Lamprey, great sea, . . .	261
137. Cod, . . .	447	55. Long Jaw, . . .	319
37. Conger, . . .	294	83. Mackerel, chub, . . .	366
94. Crab-eater, . . .	379	82. Mackerel, common, . . .	365
97. Crappie, . . .	382	86. Mackerel, Spanish, . . .	369
91. Crevalle, . . .	374	90. Mackerel, yellow, . . .	373
126. Croaker, . . .	431	76. Mascalonge, . . .	359
142. Cusk, . . .	453	78. Mascalonge, barred, . . .	360
33. Cutlips, . . .	288	77. Mascalonge, northern, . . .	360
144. Dab, rough, . . .	455	47. Menhaden, . . .	309

COMMON NAMES OF FISHES.

Num- ber.	Page.	Num- ber.	Page.
31. Minnow, lake,	288	71. Smelt,	351
38. Moon-Eye,	296	132. Spade Fish,	440
54. Moon-Eye, Cisco,	318	125. Spot,	429
39. Moon-Eye, northern,	297	61. Steelhead,	330
80. Mullet, striped,	363	7. Sturgeon, common,	266
81. Mullet, white,	365	8. Sturgeon, lake,	267
6. Paddle-fish,	265	9. Sturgeon, short-nosed,	269
110. Perch, yellow,	403	21. Sucker, common,	278
113. Perch, white,	409	22. Sucker, hog,	280
72. Pickerel, banded,	353	20. Sucker, long-nosed,	277
74. Pickerel, chain,	355	24. Sucker, northern chub,	281
73. Pickerel, little,	354	23. Sucker, southern chub,	281
117. Pig Fish,	417	25. Sucker, striped,	282
75. Pike, common,	356	26. Sucker, white-nosed,	283
109. Pike, gray,	402	104. Sunfish,	392
107. Pikeperch	398	101. Sunfish, green,	388
135. Pollack,	444	102. Sunfish, long-eared,	389
92. Pompano, common,	376	89. Sword Fish,	372
27. Red Horse,	284	30. Tench,	287
116. Red Snapper,	415	136. Tomcod,	445
133. Rosefish,	442	68. Trout, brook,	344
69. Saibling,	347	62. Trout, brown,	332
119. Sailor's Choice,	421	63. Trout, hybrid,	335
58. Salmon, Atlantic,	324	67. Trout, lake,	342
59. Salmon, landlocked,	327	60. Trout, Lake Tahoe,	329
57. Salmon, king,	323	64. Trout, Lochleven,	336
108. Sauger,	401	65. Trout, rainbow,	338
118. Scup,	419	70. Trout, Sunapee,	349
46. Shad,	305	66. Trout, Swiss lake,	340
40. Shad, gizzard,	297	56. Tullibee,	321
43. Shad, hickory,	301	84. Tunny,	367
120. Sheepshead,	422	100. Warmouth,	388
79. Silversides,	362	121. Weakfish,	424
5. Skate, barn door,	264	122. Weakfish, spotted,	426
4. Skate, clear-nosed,	264	51. Whitefish, common,	313
2. Skate, common,	262	50. Whitefish, round,	311
3. Skate, spotted,	263	134. Whiting,	443
42. Skipjack,	300	123. Yellowtail,	427
52. Smelt,	316		

Food and Game Fishes of New York.

By TARLETON H. BEAN,

CHIEF, DEPARTMENT OF FISH AND GAME, WORLD'S FAIR, ST. LOUIS.

Introductory Chapter.

THE most recent catalogue of New York fishes includes 375 species, but this is to some extent a compilation, and the number is liable to change after systematic investigations of the inland waters have been made.

The food and game fishes mentioned in this article number 149 species. These belong to 36 families, of which the most important in the number of species represented are the Catfish, the Sucker, the Minnow, the Herring, the Salmon, the Pike, the Mackerel, the Sunfish, the Weakfish, the Cod, and Flatfish families.

The State is greatly diversified in contour and has an extensive water area. Its drainage systems are the Great Lakes, Lake Champlain, the St. Lawrence, the Ohio Basin, the Susquehanna, the Delaware, the Hudson, with such adjacent small streams as the Passaic, Hackensack, Walkill and Bronx, and the great inland lakes, nearly all of which communicate with Lake Ontario.

Long Island is richer in fishes than the rest of the State, but its species are chiefly marine; its fresh waters contain few kinds and of those about one-half are recent introductions.

The only extended systematic series of observations upon the occurrence of the fishes in any part of the State appears to be recorded by the writer in the Bulletin of the American Museum of Natural History, volume IX, 1897, pages 374 to 375. This is the record of Mr. W. I. DeNyse at Gravesend Beach, Long Island, for 1895 to 1897. The following table is copied from the publication referred to as far as it relates to the food and game fishes of the present article :

W. I. DENYSE'S RECORD OF SHIPMENTS OF FISH FROM GRAVESEND BAY TO THE N. Y.
AQUARIUM, 1895-97, SHOWING THE MONTHS WHEN THE SPECIES WERE CAUGHT.

	JANUARY.	FEBRUARY.	MARCH.	APRIL.	MAY.	JUNE.	JULY.	AUGUST.	SEPTEMBER.	OCTOBER.	NOVEMBER.	DECEMBER.
Sea Lamprey, - - -			x	x		x						
Common Skate, - -			eggs x								x	
Barn Door Skate, - - -										x		
Common Sturgeon, - -				x	x						x	x
Short-nosed Sturgeon, - -					x							
Eel, - - - - -			x			x	x					x
Conger, - - - -												x
Sea Herring, - - -	x							x	x	x	x	x
Alewife, - - - -					x	x	x	x	x	x	x	
Shad, - - - -										x	x	
Menhaden, - - - -							x	x	x	x		
Smelt, - - - -	x			x								x
Silversides, - - - -			x								x	x
Striped Mullet, - - -										x		
Mackerel, - - - -					x							
Bonito, - - - -									x			
Yellow Mackerel, - - -									x	x		
Crevalle, - - - -									x	x		
Common Pompano, - -								x	x	x		
Bluefish, - - - -									x	x		
Butter Fish, - - - -					x				x	x		
Striped Bass, - - -				x		x			x		x	x
White Perch, - - - -	x			x						x	x	x
Sea Bass, - - - -				x	x	x	x	x	x	x	x	x
Scup, - - - -				x	x	x		x	x	x	x	
Sheepshead, - - -									x			
Weakfish, - - - -						x			x	x	x	
Yellowtail, - - -									x	x	x	
Spot, - - - -							x		x	x	x	x

W. I. DENYSE'S RECORD — *Continued.*

	JANUARY.	FEBRUARY.	MARCH.	APRIL.	MAY.	JUNE.	JULY.	AUGUST.	SEPTEMBER.	OCTOBER.	NOVEMBER.	DECEMBER.
Kingfish, - - - -					X			X		X		
Drum, - - - - -					X					X	X	X
Bergall, - - - -							X		X			
Blackfish, - - - -				X	X		X	X	X			X
Whiting, - - - -										X		
Tomcod, - - - - -	X		X	X	X					X	X	X
Cod, - - - - -										X	X	
Common Hake, - - -				X	X					X	X	X
Squirrel Hake, - - -										X		
Flatfish, - - - - -	X			X			X		X		X	X

The above record is not intended to show the full period during which the species are present in Gravesend Bay, as a glance at its contents will indicate. Any one familiar with the habits of the migratory and resident fishes will observe this fact. It is important, however, in the respect that it marks the duration of the stay of many valuable fishes in that body of water. It is interesting to note how many of them are present in the early winter months.

Mr. Eugene Smith of Hoboken has given me a list of fishes observed by him in Wawayanda Creek, small streams at Warwick, Greenwood Lake, Ramapo River, head streams of Saddle River and Hackensack streams. The food and game fishes obtained in these waters by Mr. Smith are: Horned Pout, Common Sucker, Chub Sucker, Brook Trout, Chain Pickerel, Eel, Rock Bass (introduced), Long-eared Sunfish, Common Sunfish, Small-mouth Black Bass, Large-mouth Black Bass and Yellow Perch.

The general distribution of the food and game fishes of New York is shown in the following table, which is based chiefly upon recent investigations, but partly upon records which have not lately been verified:

RECORDED DISTRIBUTION OF THE FOOD AND GAME FISHES OF NEW YORK.

	GREAT LAKES.	INTERIOR LAKES.	ST. LAWRENCE.	ADIRONDACKS.	LAKE CHAMPLAIN.	OHIO BASIN.	SUSQUEHANNA BASIN.	DELAWARE BASIN.	HUDSON BASIN.	LONG ISLAND STREAMS.	MARINE.	ANADROMOUS.
1. Great Sea Lamprey, -											x	x
2. Common Skate, -											x	
3. Spotted Skate, - -											x	
4. Clear-nosed Skate, -											x	
5. Barn Door Skate, - -											x	
6. Paddle-fish, - -	x					x						
7. Common Sturgeon, -			x								x	x
8. Lake Sturgeon, - -	x		x		x							
9. Short-nosed Sturgeon, -			x								x	x
10. Channel Cat, - -	x											
11. Lake Catfish, - -	x		x		x							
12. Yellow Cat, - -	x	x										
13. Long-jawed Catfish, -	x	x			x							
14. White Cat, - -							x	x	x			
15. Horned Pout, - -	x		x		x	x	x		x	x		
16. Marbled Cat, - -									x			
17. Black Bullhead, - -	x		x			x						
18. Stone Cat, - -	x											
19. Lake Carp, ° - - -	x		x		x							
20. Long-nosed Sucker, -	x	x	x		x							
21. Common Sucker,* - -	x	x	x		x	x	x	x	x			
22. Hog Sucker, - -	x					x	x	x				
23. Southern Chub Sucker,†									x			
24. Northern Chub Sucker,	x	x	x				x	x	x			
25. Striped Sucker, - -	x					x						

* Recorded also from the Walkill, Passaic and Hackensack.

† Recorded also from the Passaic and Hackensack.

RECORDED DISTRIBUTION OF THE FOOD AND GAME FISHES OF NEW YORK—*Continued.*

	GREAT LAKES.	INTERIOR LAKES.	ST. LAWRENCE.	ADIRONDACKS.	LAKE CHAMPLAIN.	OHIO BASIN.	SUSQUEHANNA BASIN.	DELAWARE BASIN.	HUDSON BASIN.	LONG ISLAND STREAMS.	MARINE.	ANADROMOUS.
26. White-nosed Sucker, -	x		x									
27. Red Horse, - - -	x	x	x		x	x			x			
28. Fallfish, - - -	x		x		x		x	x	x			
29. Horned Dace, - -	x		x		x	x	x	x	x			
30. Tench, - - -										x		
31. Lake Minnow, - -	x											
32. Horned Chub, - -	x	x				x	x		x			
33. Cutlips, - - -	x	x	x		x		x	x	x			
34. Goldfish, - - -									x	x		
35. Carp, - - - -	x	x				x			x	x		
36. Eel,* - - - -	x	x	x		x		x	x	x	x		
37. Conger, - - -											x	
38. Moon-Eye, - -	x		x		x	x						
39. Northern Moon-Eye, -	x					x						
40. Gizzard Shad, - -	x					x						
41. Sea Herring, - - -			x								x	
42. Skipjack, - - -	x					x						
43. Hickory Shad, - -												x
44. Branch Herring, -	x	x	x				x	x	x			x
45. Glut Herring, - -												x
46. Shad, - - - -	x		x									x
47. Menhaden, - - -											x	
48. Striped Anchovy, -											x	
49. Mitchill's Anchovy, -											x	
50. Round Whitefish, -	x		x	x	x							
51. Common Whitefish, -	x	x	x	x	x							
52. Smelt, New York Lakes,		x										

* Recorded also from the Walkill, Passaic and Hackensack.

RECORDED DISTRIBUTION OF THE FOOD AND GAME FISHES OF NEW YORK — *Continued.*

	GREAT LAKES.	INTERIOR LAKES.	ST. LAWRENCE.	ADIRONDACKS.	LAKE CHAMPLAIN.	OHIO BASIN.	SUSQUEHANNA BASIN.	DELAWARE BASIN.	HUDSON BASIN.	LONG ISLAND STREAMS.	MARINE.	ANADROMOUS.
53. Lake Herring, - -	x	x										
54. Moon-Eye Cisco, -		x										
55. Long Jaw, - - -	x											
56. Tullibee, - - -		x										
57. King Salmon, - -	x											
58. Atlantic Salmon, -	x		x		x				x			
59. Landlocked Salmon, -				x	x					x		
60. Lake Tahoe Trout, -				x								
61. Steelhead, - - -	x											
62. Brown Trout,* - -										x		
63. Hybrid Trout, - -										x		
64. Lochleven Trout, -										x		
65. Rainbow Trout,† - -		x		x						x		
66. Swiss Lake Trout,† -				x								
67. Lake Trout, - - -	x	x	x	x	x							
68. Brook Trout,‡ - -		x	x	x	x	x		x		x		
69. Saibling,§ - - -												
70. Sunapee Trout,† -												
71. Smelt, - - - -											x	x
72. Banded Pickerel, -								x	x	x		
73. Little Pickerel, - -	x					x						
74. Chain Pickerel,‡ -	x	x	x		x				x	x		
75. Common Pike, - -	x	x	x		x							
76. Mascalonge, - -	x		x		x							

* Introduced into many trout waters.

† Introduced into Lake George.

‡ Recorded also in the Walkill and Passaic.

§ Introduced into Sterling Lake.

RECORDED DISTRIBUTION OF THE FOOD AND GAME FISHES OF NEW YORK — *Continued.*

	GREAT LAKES.	INTERIOR LAKES.	ST. LAWRENCE.	ADIRONDACKS.	LAKE CHAMPLAIN.	OHIO BASIN.	SUSQUEHANNA BASIN.	DELAWARE BASIN.	HUDSON BASIN.	LONG ISLAND STREAMS.	MARINE.	ANADROMOUS
77. Northern Mascalonge, -	x		x		x							
78. Barred Mascalonge, -						x						
79. Silversides, - - -											x	
80. Striped Mullet, - -											x	
81. White Mullet, - - -											x	
82. Common Mackerel, -											x	
83. Chub Mackerel, - -											x	
84. Tunny, - - - -											x	
85. Bonito, - - - -											x	
86. Spanish Mackerel, -											x	
87. Cero, - - - -											x	
88. King Fish ; Sierra, -											x	
89. Sword Fish, - - -											x	
90. Yellow Mackerel, -											x	
91. Crevallé, - - - -											x	
92. Common Pompano, -											x	
93. Bluefish, - - - -									x		x	
94. Crab-eater, - - -									x		x	
95. Harvest Fish, - - -											x	
96. Butter Fish, - - -											x	
97. Crappie, - - - -	x											
98. Calico Bass, - - -	x	x										
99. Rock Bass, - - - -	x	x	x		x	x				x		
100. Warmouth, - - - -	x											
101. Green Sunfish, - -	x	x										
102. Long-eared Sunfish, -									x			
103. Blue-gill, - - - -	x	x				x						

RECORDED DISTRIBUTION OF THE FOOD AND GAME FISHES OF NEW YORK — *Continued.*

	GREAT LAKES.	INTERIOR LAKES.	ST. LAWRENCE.	ADIRONDACKS.	LAKE CHAMPLAIN.	OHIO BASIN.	SUSQUEHANNA BASIN.	DELAWARE BASIN.	HUDSON BASIN.	LONG ISLAND STREAMS.	MARINE.	ANADROMOUS.
104. Sunfish,* - - -	x	x	x	x	x	x	x	x	x	x		
105. Small-mouth Black Bass,†	x	x	x	x	x	x	x	x	x	x		
106. Large-mouth Black Bass,‡	x	x	x	x	x	x	x	x	x	x		
107. Pike Perch, - - -	x	x	x		x	x	x	x				
108. Sauger, - - -	x	x	x		x							
109. Gray Pike, - - -	x	x										
110. Yellow Perch,§ - -	x	x	x	x	x	x	x	x	x	x		
111. White Bass, - -	x					x						
112. Striped Bass, - -			x				x	x	x	x		x
113. White Perch, - -									x	x		x
114. Sea Bass, - - -											x	
115. Flasher, - - -											x	
116. Red Snapper, - -											x	
117. Pig Fish, - - -											x	
118. Scup, - - -											x	
119. Sailor's Choice, - -											x	
120. Sheepshead, - -											x	
121. Weakfish, - - -											x	
122. Spotted Weakfish, -											x	
123. Yellowtail, - - -											x	
124. Red Drum, - -											x	
125. Spot, - - - -											x	
126. Croaker, - - -											x	
127. Kingfish, - - -											x	

* Recorded also from the Walkill, Passaic and Hackensack.

† Introduced into the Passaic.

‡ Recorded from the Walkill, Passaic and Bronx.

§ Recorded also from the Passaic and Hackensack.

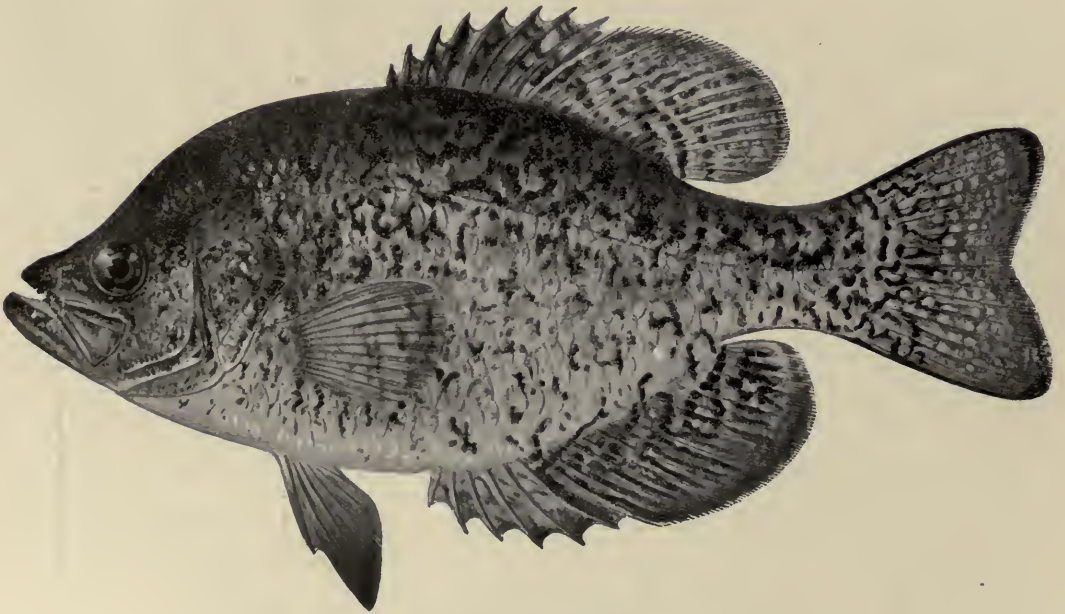
|| Introduced into Greenwood Lake.

RECORDED DISTRIBUTION OF THE FOOD AND GAME FISHES OF NEW YORK — *Concluded.*[illegible]

The names employed in this catalogue are essentially the same as those used in "Fishes of North and Middle America" by Jordan & Evermann. Some of the specific names differ from those given by Jordan & Evermann for reasons which are fully explained in the author's "Catalogue of the Fishes of New York," forming Bulletin 60 of the New York State Museum.

The references to the literature are purposely limited to the writings of Mitchill, DeKay, and a few more recent authors who have written especially about the fishes of the State, or whose works contain descriptions of all the species.

Illustrations of the fishes have been freely introduced in order to furnish the easiest method of identification by the non-scientific reader. The use of these illustrations was made possible by the courtesy of Hon. George M. Bowers, U. S. Commissioner of Fish and Fisheries.



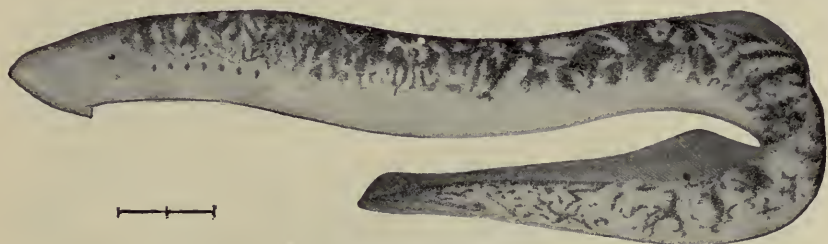
98. THE CALICO BASS.

Notes on Common Names, Distribution, Habits and Capture of New York Fishes.

I. Great Sea Lamprey (*Petromyzon marinus* Linnæus).

Petromyzon marinus MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 461, 1815; DEKAY, N. Y. Fauna, Fishes, 379, pl. LXVI, fig. 216, 1842; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 10, 1896, pl. I, fig. 3, 1900.

The Sea Lamprey, or Lamprey Eel, inhabits the North Atlantic, ascending streams to spawn. The species ranges southward on our coast to Virginia. In the Delaware, Susquehanna, and their tributaries, this is a common fish. Its larval form, which is blind and toothless, is extremely abundant in muddy sandflats near the mouths of small streams and is a very important bait for hook and line fishing.



GREAT SEA LAMPREY.

The Sea Lamprey grows to a length of 3 feet. It is dark brown in color, mottled with black and white. In the breeding season, in spring, the males have a high fleshy ridge in front of the dorsal. The spawning is believed to take place in May or June. The eels cling to the rocks by means of their suctorial mouths and the eggs are deposited in shallow water on a rough bottom where the current is swift. Some observers state that they make nests by heaping up stones in a circle and deposit the eggs under the stones. The ovaries are large, but the eggs are very small.

The food of the Lamprey is chiefly animal matter and the fish is somewhat of a parasite, burrowing into the side of shad, sturgeon and some other species. The teeth are adapted for this method of feeding. The tooth bearing bone of the upper side of the mouth contains two teeth which are placed close together. On the bone corresponding with the lower jaw there are seven or nine stout cusps. There are numerous teeth around the disk; the first row on the side of the mouth containing

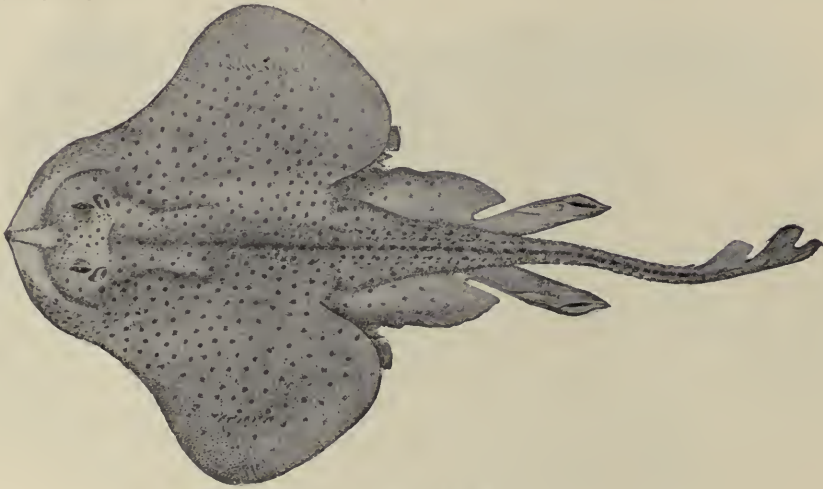
bicuspid teeth, the others are simple. The tooth on the front of the tongue has a deep median groove. The species is adapted for fastening itself to other fishes and extracting from them their blood.

The Lamprey is considered a good food fish in some localities, but in other places it is rarely eaten. In Connecticut and Massachusetts the species is highly esteemed. It is preserved by salting for several weeks before using. The fish are sometimes caught with the hands or by means of a pole armed with a hook in the end. As it is found in shallow water and will not usually relinquish its hold on the bottom, its capture is easily effected.

2. Common Skate (*Raja erinacea* Mitchill).

Raja erinaceus MITCHILL, Am. Jour. Sci. Arts, IX, 290, pl. 6 (male), 1825 ; DEKAY, N. Y. Fauna, Fishes, 372, pl. LXXVIII, fig. 246, 1842.

Raja erinacea JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 68, 1896, pl. IX, fig. 29, 1900.



COMMON SKATE.

A very common species on our coast, from Maine to Virginia. It is one of the small rays and is not much valued for food. Eggs of this Skate have been obtained in Gravesend Bay in March. In captivity eggs have been deposited in winter. The species will endure captivity during the spring, fall, and part of the winter, but not at all in summer.

Mitchill had the ray from Barnegat and from off Sandy Hook. DeKay did not see the fish, but copied the description and figure of Mitchill. Smith refers to it as the "Summer Skate" or "Bonnet Skate." It is found at Woods Hole from June to October. The names "Hedgehog Ray" and "Bonnet Skate" are given in

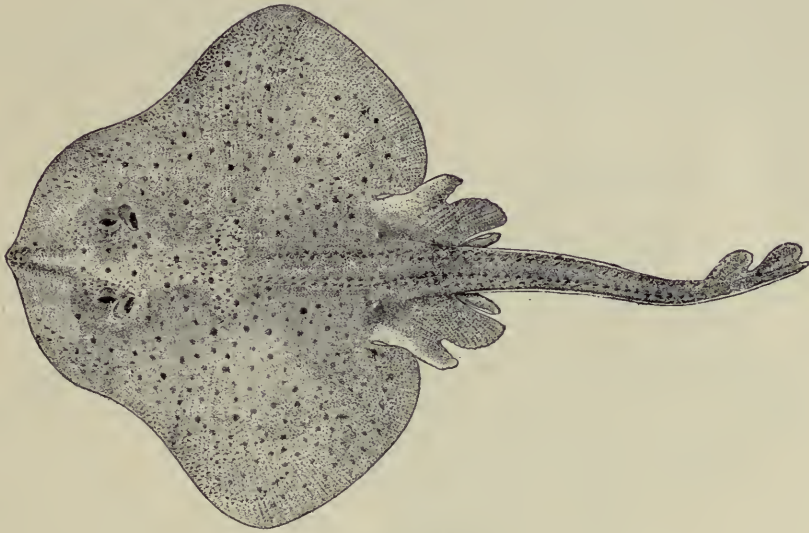
allusion to its habit of rolling itself up when caught. At Southampton, L. I., this species was taken in small numbers August 3, 1898.

3. Spotted Skate (*Raja ocellata* Mitchill).

Raja ocellata MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 477, 1815.

Raia ocellata DEKAY, N. Y. Fauna, Fishes, 369, 1842 (not pl. 65, fig. 212).

The Spotted Skate reaches a length of nearly 3 feet; its egg cases are more than twice as large as those of *R. erinacea*. The species is found from New York to Massachusetts and northward.



SPOTTED SKATE.

Dr. Mitchill described a specimen which was 30 inches long and 19 inches wide. Dr. DeKay calls this species the Spotted Ray. He found the stomach of one filled with rock crabs (*Cancer irroratus*). To the fishermen this and allied species are known as Skate. It has no commercial value in Great South Bay. In the traps at Islip Skates reappear on October 1 on their fall migration. A female was caught near the inlet, at Fire Island, September 29, 1898. The species was more abundant later in the fall.

At Woods Hole, according to Dr. Smith, this is the Big Skate or Winter Skate. It is common from February to June and from October 15 to the end of the trap fishing; it is absent or very rare in summer.

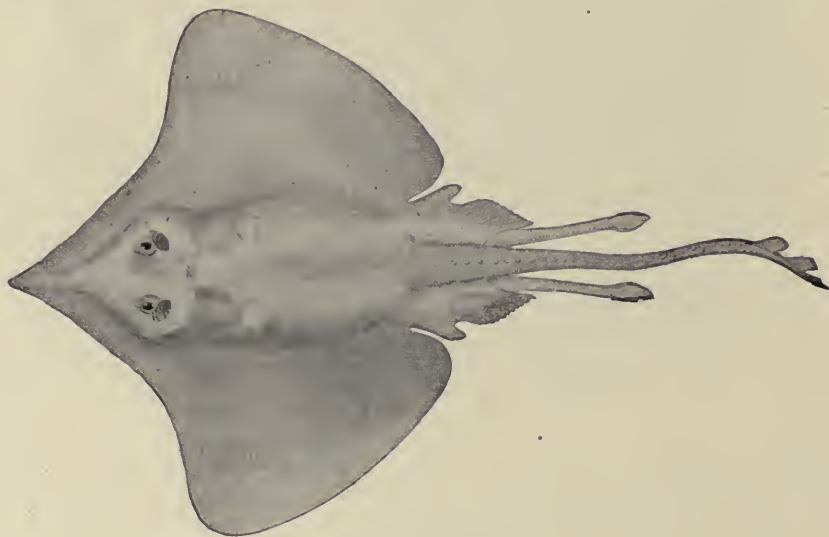
4. Clear-nosed Skate (*Raja eglanteria* Bosc).

Raja eglanteria BOSC in LACÉPÈDE, Hist. Nat. Poiss., II, 104, 109, 1800; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 71, 1896.

Raja diaphanes MITCHILL, Trans. Lit. & Phil. Soc. N. Y., 478, 1815.

The Clear-nosed Skate, sometimes called Briar Ray, reaches a length of 2 feet or more. It inhabits the Eastern Coast of the United States from Cape Cod to Florida; it has been found moderately common in Great South Bay in and near Fire Island Inlet. Early in September both males and females were caught at Fire Island Inlet and Wigo Inlet, but in October the species appeared to be scarce. It has no commercial value in the bay and is usually thrown away.

At Woods Hole, Mass., it is not common. A few are taken every year in traps at Menemsha, Martha's Vineyard.



BARN DOOR SKATE.

5. Barn Door Skate (*Raja laevis* Mitchill).

Raja laevis MITCHILL, Am. Month. Mag., II, 327, 1818.

Raia laevis DEKAY, N. Y. Fauna, Fishes, 370, 1842.

The Barn Door Skate reaches a length exceeding 4 feet; it is used to some extent for food. The species has been taken in Gravesend Bay in October. It suffers in captivity for the want of sand and mud and because of the lack of suitable food, its average duration of life being 3 or 4 months.

Mitchill described an individual measuring 49 inches which was caught at a

wharf in the East River, November 5, 1815. At Woods Hole, Mass., it is common in spring and fall, rare in summer.

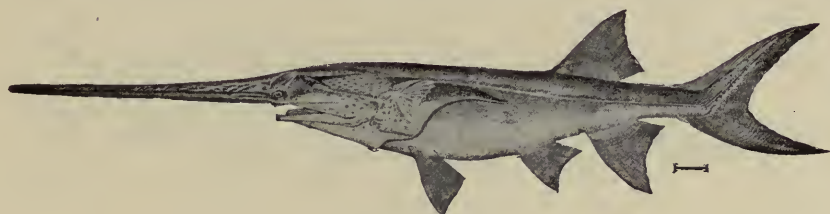
6. Paddle-Fish (*Polyodon spathula* Walbaum).

Polyodon folium MITCHILL, Am. Jour. Sci. Arts, XII, 201, 1827.

Polyodon spathula JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 101, 1896.

This is known as the Paddle-fish, Spoonbill or Spoon-billed Sturgeon, Shovel Fish, Bill Fish, and Duck-billed Cat. It is called "Salmon" in some Western hotels. The names are derived from the remarkable snout, which is produced into a long spatula-shaped process, covered above and below with an intricate network and with very thin flexible edges. The head and snout form nearly half of the entire length of the fish. The fish cannot be confounded with anything else in the waters of the United States. There is in China a similar fish, which, however, belongs to a different genus.

The Paddle-fish is usually confined to the Mississippi Valley, but it has been



PADDLE-FISH.

recorded in Chautauqua Lake, and it is common in the Alleghany and the Monongahela Rivers. It grows to a length of 6 feet, and a weight of 30 pounds or more. The species frequents muddy bottoms, but does not feed on the mud and slime, as many persons have supposed. The long snout is useful in procuring its food, which consists chiefly of entomostraca, water worms, aquatic plants, leeches, beetles and insect larvæ.

Prof. S. A. Forbes, director of the Illinois Laboratory of Natural History, has published the first and most satisfactory account of the feeding habits of this shark-like fish. He found very little mud mixed with the food. Prof. Forbes was informed by the fishermen that the Paddle-fish plows up the mud in feeding with its spatula-like snout and then swims slowly backward through the water.

"The remarkably developed gill-rakers of this species are very numerous and fine, in a double row on each gill-arch, and they are twice as long as the filaments of the gill. By their interlacing they form a strainer scarcely less effective than the

fringes of the baleen plates of the whale, and probably allow the passage of the fine silt of the river bed when this is thrown into the water by the shovel of the fish, but arrest everything as large as the *Cyclops*. I have not found anything recorded as to the spawning habits of the Paddle-fish. The young have the jaws and palate filled with minute teeth, which disappear with age."

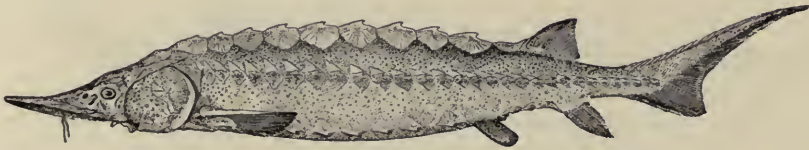
The flesh of the Paddle-fish is frequently considered tough and shark-like, but individuals of 8 or 10 pounds are skinned, and sold in some of the western markets freely, and are thought by some persons to be fairly good for the table.

7. Common Sturgeon (*Acipenser sturio* Linnæus).

Acipenser sturio LINNÆUS, Syst. Nat., ed. x, I, 237, 1758; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 105, 1896.

Acipenser oxyrhincus DEKAY, N. Y. Fauna, Fishes, 346, pl. 58, fig. 189 (young), 1842.

The range of the Common Sturgeon includes the Atlantic Ocean southward to Africa and the West Indies. The northern limit on our east coast appears to be Cape Cod. In the Delaware River the fish has rarely ascended as far as Port Jarvis.



COMMON STURGEON.

Dr. Mitchill was the first to call attention to the similarity between the American Sharp-nosed Sturgeon and the *sturio* of Europe. The fish attains a length of 12 feet in America, and it is stated that European examples measuring 18 feet have been taken.

The sturgeon ascends the large rivers from the sea in spring and early summer. It is very common in the lower part of the Delaware River, where it forms the object of an important fishery. This is the species concerning which so many stories have been related as to its leaping into boats and injuring the occupants.

The mouth of the sturgeon is furnished with a very protractile roundish tube having powerful muscles and intended for withdrawing from the mud the various small shellfish and crustaceans on which the animal subsists. The mouth is surrounded also with numerous tentacles, with tactile properties, which are utilized in procuring food.

The reproductive habits of the sturgeon and the embryology of the species have been made the subject of an exhaustive study by the late Prof. John A. Ryder

of the University of Pennsylvania, whose monograph forms a part of the Bulletin of the U. S. Fish Commission for 1888. The eggs have been fertilized and developed artificially by Seth Green and others many years ago, and in some parts of Europe the hatching of the species has been carried on successfully. The U. S. Fish Commission has also recently taken up the culture both of the marine and the lake sturgeon, and these valuable fish may soon be reared on an extensive scale.

The utilization of the flesh, the skin and air-bladder and the eggs of the sturgeon is so well known as to require little more than passing mention in this place. The smoking of the flesh and the manufacture of caviare from the eggs are very important industries along our eastern coast.

The sturgeons are easily taken in gill nets and pounds, but the great strength of the fish frequently entails considerable loss of apparatus.

The Common Sturgeon appears every spring in Gravesend Bay, and sometimes in the fall. It is hardy in captivity. A female 8 feet long was brought from the mouth of the Delaware River, May 20, 1897, to the New York Aquarium. It seemed to take no food till December 1, when it began to feed freely on opened hard clams.



LAKE STURGEON.

8. Lake Sturgeon (*Acipenser rubicundus* LeSueur).

Acipenser rubicundus DEKAY, N. Y. Fauna, Fishes, 344, pl. 58, fig. 191, 1842; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 106, 1896.

This is known as the Lake Sturgeon, Ohio River Sturgeon, Rock Sturgeon, Bony Sturgeon, Red Sturgeon and Ruddy Sturgeon. It inhabits the Mississippi and Ohio Rivers and the Great Lakes, and is abundant in the Alleghany. From the lakes it ascends the streams in spring for the purpose of spawning. Dr. Richardson states that the northern limit of the sturgeon in North America is about the 55th parallel of latitude.

The Lake Sturgeon is smaller than the common marine sturgeon, the average adult being less than 5 feet in length. The average weight of 14,000 mature sturgeon taken at Sandusky, O., was about 50 pounds. It frequently reaches a length of 6 feet.

In the Lakes the species, according to observations of James W. Milner, inhabits

comparatively shoal waters. The food of this sturgeon is made up chiefly of shellfish, including the genera *Limnæa*, *Melantho*, *Physa*, *Planorbis* and *Valvata*. Eggs of fishes are also to be found in its stomach.

In Lake Erie the species spawns in June, for which purpose it ascends the rivers in large schools till stopped by obstructions or insufficient depth of water. The breaching of the sturgeon is a well-known habit. Instances are recorded of serious injury to persons by sturgeons throwing themselves into boats. The sturgeon will occasionally take a baited hook, but its great strength and unwieldiness make it an undesirable fish for the angler.

Large numbers of sturgeon have been destroyed by fishermen during the whitefish season simply on account of the annoyance caused by their presence in the nets. Now that the flesh is esteemed for smoking, and the demand for caviare made from the eggs has largely increased, the wanton waste of this fish has been checked. A troublesome parasite of the sturgeon is the lamprey eel (*Petromyzon concolor* Kirt.) which attaches itself to the skin presumably for the purpose of feeding on the mucus which is exuded from the pores in great abundance, and remains fixed in one position so long as to penetrate to the flesh and produce a deep ulcerous sore.

The Lake Sturgeon was formerly not very much prized, but is rapidly growing in favor. The flesh is eaten in the fresh condition or after boiling in vinegar or curing by smoking. Smoked sturgeon is now considered almost if not quite equal to smoked halibut, and the demand for it is increasing. From the eggs of the sturgeon a good grade of caviare is produced. "The caviare is made by pressing the ova through sieves, leaving the membranes of the ovaries remaining in the sieve, and the eggs fall through into a tub. This is continued until the eggs are entirely free from particles of membrane, when they are put into salt pickle and allowed to remain for some time."

A large specimen now in the museum of Cornell University is reported as being from Cayuga Lake. Seth Green informed Dr. Meek that sturgeons had occasionally been taken in that lake; but so far as he knew, they had never been found in any other of the small lakes of Central New York.

H. V. Kipp, of Montezuma, N. Y., wrote Dr. Meek as follows: "There have not been any sturgeons taken from Cayuga Lake since 1880, but quite a number before that date, and the largest known weighed 35 pounds."

9. Short-nosed Sturgeon (*Acipenser brevirostrum* LeSueur).

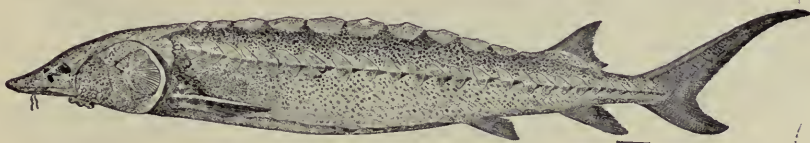
Acipenser brevirostrum JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I. 106, 1896.

This little sturgeon has not been positively recognized anywhere except in the Delaware and in Gravesend Bay; only a few specimens have been obtained in the river, and it is rare in Gravesend Bay. Prof. Ryder collected five examples at Delaware City in the spring of 1888, and has published a description of the species in the Bulletin of the U. S. Fish Commission for that year.

The largest specimen known was 33 inches long; individuals 20 inches long are capable of reproducing the species.

At the present time the Short-nosed Sturgeon probably never comes into the markets on account of its small size, which prevents its capture in the nets used for taking the common sturgeon. About 1817, however, it was brought in the shad season to Philadelphia and sold for 25c. to 75c. each.

Spawning takes place in the Delaware during May. The eggs are deposited in depths of 1 to 5 fathoms on hard bottom in brackish or nearly fresh water. Prof.



SHORT-NOSED STURGEON.

Ryder states that the eggs are extruded by rubbing the belly either against hard places on the river bed or against the rough bodies of the males, two or more of which accompany each female. The gravid roe fish are larger than the males. Prof. Ryder found the ova more or less adhesive immediately after their removal from the abdomen, but the sticky mucus covering is soluble in water. The period of hatching varies from four to six days.

Up to the third month of its life the young sturgeon has minute conical teeth in its jaws, and at this age it is believed to subsist on "rhizopods, unicellular algæ, infusoria, minute larvæ of insects and worms, crustaceans, etc." Still following the observations of Prof. Ryder, we learn that the sturgeon, when it has reached a length of 1 inch to 1½ inches, has minute teeth on the floor of the pharynx and feeds on small water fleas, and probably algæ, worms, embryo fishes, insects and fresh-water copepods. Later in life the fish seeks larger crustaceans, and the adults occasionally contain fragments of mussel shells. The young fish have been caught under the ice in midwinter and are known to pass most of the year in fresh water.

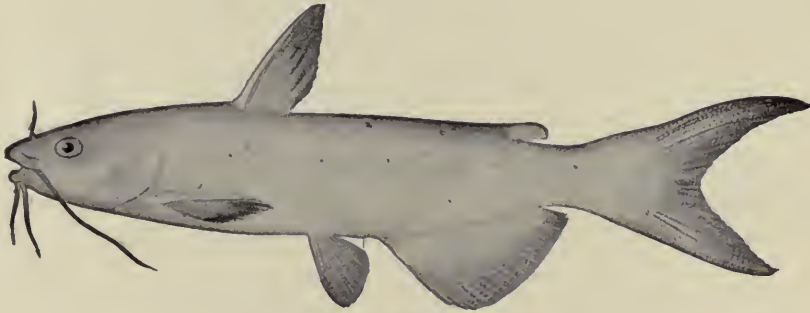
A single small example of this sturgeon was brought to the New York Aquarium from Gravesend Bay, May 13, 1896, and was alive and in good condition in November, 1898.

Dr. Smith records the occurrence of the species along with the common sturgeon at Woods Hole, Mass., but says it is less numerous. It is captured in the traps.

10. Channel Cat (*Ictalurus punctatus* Rafinesque).

Ictalurus punctatus JORDAN, Bull. Buffalo Soc. Nat. Hist., 95, 1876 ; JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 108, 1883 ; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 134, 1896, pl. XXV, fig. 58, 1900.

This species is variously styled the Channel Cat, White Cat, Silver Cat, Blue Cat and Spotted Cat. It is found over a vast extent of country, including the



CHANNEL CAT.

Mississippi and Ohio Valleys and the Great Lakes region. In the Eastern States it is absent from streams tributary to the Atlantic, but occurs from Vermont south to Georgia, westward to Montana, and southwestward to Mexico. In Pennsylvania it is limited to the Ohio and its affluents.

The adults of this species are bluish silvery, and the young are spotted with olive. It is one of the handsomest of the family of catfishes and an excellent food fish. The Spotted Cat grows to a length of 3 feet and a weight of 25 pounds. It is extremely variable in color and in number of fin rays, and has consequently been described under more than 20 different names. It is most abundant in large clear streams. The species is less hardy than most of the other catfishes.

II. Lake Catfish (*Ameiurus lacustris* Walbaum).

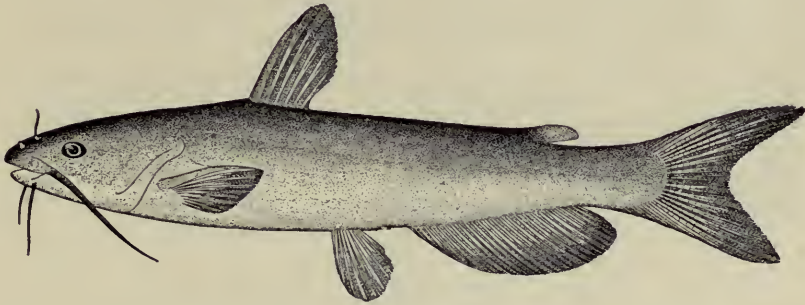
Ictalurus nigricans JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 108, 1883.

Pimelodus nigricans DEKAY, N. Y. Fauna, Fishes, 180, pl. 52, fig. 170, 1842.

Ameiurus lacustris JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 137, 1896.

This is the Great Fork-tailed Cat, Florida Cat, Flannel-mouth Cat, and Great Blue Cat of various writers. It is also called Mud Cat in the St. John's River, Fla. The species is highly variable, as we would suppose from its wide distribution.

In 1879, Prof. Spencer F. Baird received from Dr. Steedman of St. Louis, a Mississippi River Catfish weighing 150 pounds and measuring 5 feet in length. The writer described this fish as a new species related to the Great Black Catfish of the Mississippi Valley, *Ameiurus nigricans*. At the present time it is somewhat doubtful whether or not this is merely an overgrown individual of the species under consideration and the matter must remain in doubt till smaller examples of *Ameiurus ponderosus* have been obtained.



LAKE CATFISH.

The Great Fork-tailed Cat is a native of the Ohio and Mississippi Valleys, and in the Southern States its range extends southward to Florida; northward it ranges to Ontario.

This Catfish reaches a weight of 100 pounds or more, and, if it includes the giant form above referred to, we may place the maximum weight at more than 150 pounds. Dr. Steedman was informed by an old fisherman that the heaviest one he had ever seen weighed 198 pounds, but it is doubtful that such large individuals are to be taken at the present time. In Lake Erie this species usually weighs from 5 to 15 pounds, and the largest specimens reach 40 pounds.

The habits of this fish are presumably about the same as those of other species of the family. On account of the great size of the fish it naturally prefers lakes and large rivers. It is a bottom feeder and will take almost any kind of bait. This species is wonderfully tenacious of life. It spawns in the spring and protects its

young, which follow the parent fish in great schools. Dr. Theodore Gill has reviewed in *Forest and Stream* the subject of the Catfishes' care of their young.

This is a valued food species, though not a choice fish. In Lake Erie, according to a Review of the Fisheries of the Great Lakes, published by the U. S. Fish Commission, the Catfish rank next to Whitefish in number of pounds taken.

In Lake Erie Catfish are taken chiefly by means of set lines, and the fishing is best during the months of June, July, and August. The method of fishing is thus described in the Review just referred to: "The apparatus consists of from 200 to 400 hooks attached by short lines to a main line, which is from 5 to 27 fathoms long, according to place in which set, and is held in place by poles or stakes pushed into the mud. The lines are usually set in the lake, but occasionally short ones are fished in the bayous and marshes. Catfish are taken with a bait of herring, *Coregonus artedii*, or grasshoppers, and are mostly used in the families of the fishermen and their neighbors or sold to peddlers. * * * The size of the Catfish ranges from 5 to 25 pounds, averaging 8 or 10 pounds." In some parts of Lake Erie the set line fishery for Catfish begins April 15. Some of these lines have as many as 2,000 hooks. The pound nets also take a good many Catfish in the spring and fall. In Toledo these fish bring 4½ cents a pound. Erie receives its supply of Catfish from fishermen who operate in the lake from Erie to Elk Creek with set lines during the summer months. DeKay had the species from Buffalo, where he saw specimens weighing from 25 to 30 pounds, and heard of individuals weighing 80 pounds. He states that it is usually captured by the spear.

12. Yellow Cat (*Ameiurus natalis* LeSueur).

Pimelodus cupreus DEKAY, N. Y. Fauna, Fishes, 187, 1842 (Name only).

Ameiurus natalis JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 139, 1896.

The Yellow Cat, or Chubby Cat, is found from the Great Lakes to Virginia and Texas. It has many varieties, three of which are mentioned by Prof. Cope as occurring in Pennsylvania, two of them in the Ohio River and its tributaries and the third in Lake Erie. The species is not credited to the region east of the Alleghanies. Dr. Meek saw only a single specimen from Cayuga Lake.

The length of the Yellow Cat sometimes reaches 2 feet, but averages much less.

Nothing special is recorded about the habits of this species. It is most abundant in sluggish streams.

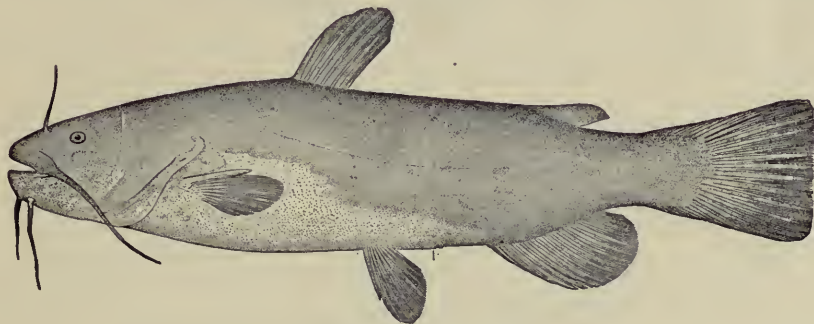
13. Long-jawed Catfish (*Ameiurus vulgaris* Thompson).

Amiurus dekayi BEAN, Fishes Penna., 15, pl. 18, fig. 24, 1893.

Ameiurus vulgaris JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 140, 1896.

The Long-jawed Catfish is found in the Great Lakes region and westward to Manitoba. It is believed to be very nearly related to the common catfish, *A. nebulosus*, but its projecting lower jaw will serve to distinguish it. This character, however, we know by experience is not so satisfactory as it might be.

The species reaches the length of 18 inches and the weight of 4 pounds. It is occasionally taken in the Ohio River, but is more abundant in Lake Erie. Jordan & Evermann state its range to be from Vermont to Minnesota and Illinois, chiefly northward. The U. S. National Museum has it from Manitoba. Dr. Meek found a single specimen which was caught near Ithaca among more than 100 of the common bullheads. It seems to be rare in that basin. Thompson, who described the fish, had specimens from Lake Champlain. The Long-jawed Catfish is similar



LONG-JAWED CATFISH.

in all respects except its projecting lower jaw to the common catfish, *A. nebulosus*, and may be found identical with it.

14. White Cat (*Ameiurus catus* Linnæus).

Pimelodus atrarius DEKAY, N. Y. Fishes. 185, pl. 36, fig. 116, 1842.

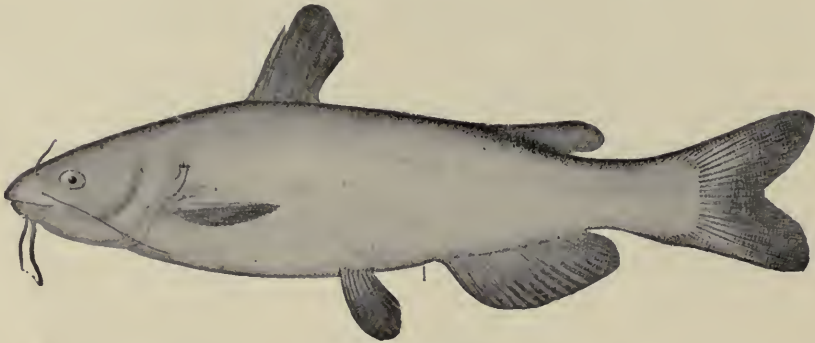
Amiurus albidus JORDAN, Bull. 10, U. S. Nat. Mus. 84, 1877, figs. 15 & 16, 1877; BEAN, Fishes Penna., 14, pl. 18, fig. 23, 1893.

This is the White Cat or Channel Cat, in Philadelphia distinguished as the Schuylkill Cat. The Channel Cat is one of the most abundant of its family in the Potomac River. It is abundant in the Susquehanna and common in the Schuylkill. This species reaches a length of 2 feet and a weight of 5 pounds. It is extremely variable with age. Old examples have the mouth so much wider than it is in the young that they have been described as a distinct species. The Big-mouthed

Cat of Cope is now considered to be the old form of the White Cat. The habits of this species agree with those of other species already mentioned. The name Channel Cat suggests a favorite haunt of the fish. As a food it is highly prized.

Eugene Smith says this catfish occurs in all the larger streams subject to the tide in the vicinity of New York City.

It is frequently caught on set lines with liver or killy bait and bites best at night. The flesh is much better flavored than that of *A. nebulosus*.



WHITE CAT.

15. Horned Pout (*Ameiurus nebulosus* LeSueur).

Pimelodus catus DEKAY, N. Y. Fauna, Fishes, 182, pl. 37, fig. 119, 1842.

Amiurus nebulosus BEAN, Fishes Penna., 16, pl. 19, fig. 25, 1893.

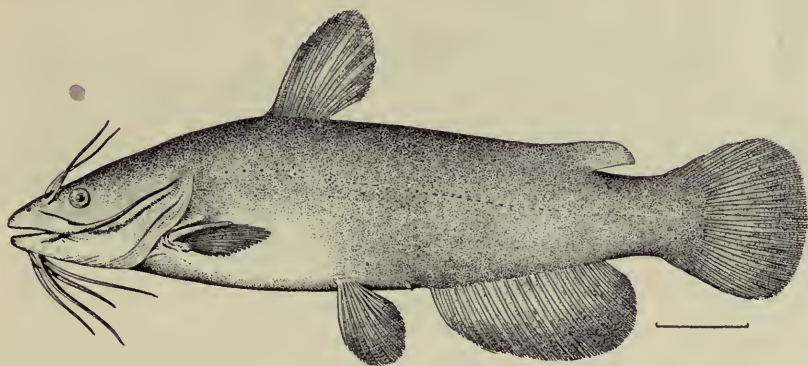
This is known as the Common Catfish, Bullhead, Horned Pout, and Minister.

This species has a wider distribution than the White Cat, its range including New England and extending southward to South Carolina, west to Wisconsin and southwest to Texas. It has also been transferred from the Schuylkill to the Sacramento and San Joaquin Rivers, Cal., where it has multiplied so rapidly that it is now one of the most common fishes of those streams. This is the most abundant catfish in Lake Erie and its tributaries. The species reaches a maximum length of 18 inches and a weight of 4 pounds, but the average size of market specimens is much smaller. In the lower waters of the Susquehanna color varieties of this species are not uncommon. One of them appears to be the same as the *Amiurus marmoratus* of Holbrook; this supposed color variety is found also from Illinois to Florida. The lower Susquehanna has furnished also some singularly colored examples of this fish, distinguished by large areas of jet black with lemon and white. These freaks are among the most interesting and beautiful observed in this family of fishes.

From Jordan's Manual of the Vertebrates I quote Thoreau's account of the habits of this species:

The horned pout are "dull and blundering fellows," fond of the mud, and growing best in weedy ponds and rivers without current. They stay near the bottom, moving slowly about with their barbels widely spread, watching for anything eatable. They will take any kind of bait, from an angleworm to a piece of tin tomato can, without coquetry, and they seldom fail to swallow the hook. They are very tenacious of life, "opening and shutting their mouths for half an hour after their heads have been cut off." They spawn in spring, and the old fishes lead the young in great schools near the shore, seemingly caring for them as a hen for her chickens.

The species was obtained in Swan River at Patchogue, N. Y., August 12, 1898. Young were seined in Bronx River in August. Larger individuals were sent from Canandaigua Lake and Saranac Lake in November. Several albinos were obtained from the Hackensack Meadows, N. J., in August, 1897. In three months they grew from 3 inches to 6 inches in length. In captivity the fish feed freely on chopped hard clams and earthworms and, occasionally, liver.



HORNED POULT.

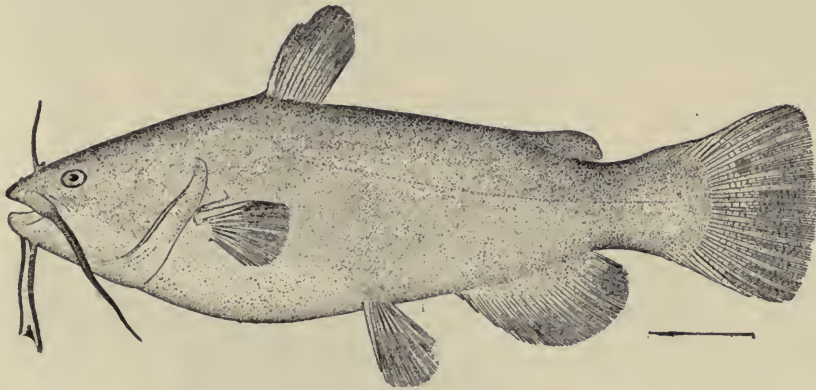
The following notes are from Eugene Smith, in Proc. Linn. Soc. N. Y., 1897, p. 11-12.

Very variable in color, from blackish and olive to brown and yellowish above, becoming lighter below, and often clouded on the sides. Those from tidal or running water are lighter colored than those from stagnant places or ponds. The largest specimen found by me in the near vicinity of New York measured $13\frac{1}{2}$ inches in length and weighed 1 pound 2 ounces.

At the end of the third year this fish is perhaps fully matured. The ripe eggs are of the size of large pin heads, and are of an orange color; the very young fishes look like little black toad tadpoles. The spines are strongly developed at an early age. The old fish accompanies the brood for a certain time, always swimming around the swarm of young in order to keep them together. When alarmed the parent dashes off, followed by the whole swarm.

16. Marbled Cat (*Ameiurus nebulosus marmoratus* Holbrook).*Ameiurus marmoratus* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 104, 1883.*Ameiurus nebulosus marmoratus* JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 141, 1896.

Body moderately elongate, its depth about one-fourth total length to caudal base; slope of profile very steep; jaws equal or subequal; dorsal fin high, its spine more than one-half as long as head, and nearer to adipose fin than to tip of snout; head long, three and one-fourth times in total length to caudal base; barbels long; anal rays 21; body much mottled with brown, greenish and whitish. Lowland streams and swamps from New York to Southern Indiana and Florida. The type of the *marmoratus* of Holbrook was from South Carolina.



BLACK BULLHEAD.

17. Black Bullhead (*Ameiurus melas* Rafinesque).*Pimelodus pullus* DEKAY, N. Y. Fauna, Fishes, 184, pl. 37, fig. 117, 1842.*Ameiurus pullus* BEAN, Fishes Penna., 16, 1893.

The Black Bullhead reaches the length of 1 foot. It is found in the Great Lakes region and in the Mississippi Valley, westward to Kansas and southward to Texas.

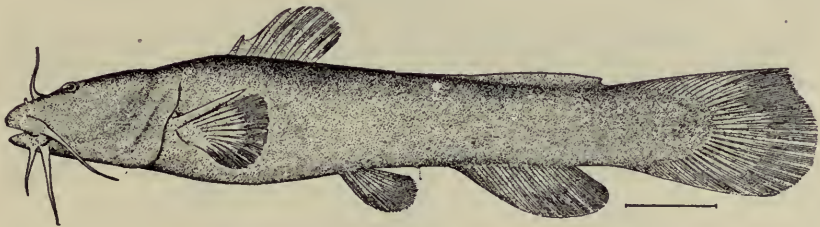
This species was known to DeKay as the Brown Catfish. His specimens were taken from Lake Pleasant and Lake Janet, N. Y., and he states that it is also very common in many other lakes of Northern New York, where its principal use is to serve as bait for the lake trout. Dr. Jordan had it from the Genesee River. Dr. Evermann obtained a specimen in Mill Creek, at Sacket Harbor, N. Y., July 2, 1894, and doubtfully referred to this species a young individual collected in Sandy Creek, at North Hamlin, N. Y., August 20, 1894.

18. Stone Cat (*Noturus flavus* Rafinesque).

Noturus flavus JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus. 100, 1883; BEAN, Fishes Penna., 18, 1893; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 144, 1896, pl. 27, fig. 63, 1900.

The Stone Cat is found from Ontario, throughout the Great Lakes region, south to Virginia and Texas, west to Montana and Wyoming. It inhabits the larger streams. Dr. Evermann obtained two specimens at Nine Mile Point, in the Lake Ontario region, June 11, 1893.

The species has very little value as food on account of its small size. It seldom exceeds 12 inches in length, but it is a very good bait for Black Bass. The Stone Cats are much dreaded by fishermen because of the painful wounds sometimes produced by their pectoral spines. There is a minute pore in the axil of the pectoral, which is the outlet of a noxious liquid secreted by a poison gland. When this poison is discharged into a wound, it causes an extremely painful sore.



STONE CAT.

19. Lake Carp (*Carpiodes thompsoni* Agassiz.)

Carpiodes thompsoni JORDAN, Bull. 12, U. S. Nat. Mus. 198, 1878; JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 119, 1883.

Abundant in the Great Lakes region. Found in Lake Champlain.

20. Long-nosed Sucker (*Catostomus catostomus* Forster).

Catostomus longirostris JORDAN, Bull. 12, U. S. Nat. Mus. 175, 1878; JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus. 126, 1883.

Catostomus catostomus, BEAN, Fishes Penna., 25, pl. 20, fig. 30, 1893.

The Northern Sucker, Long-nosed Sucker, or Red-sided Sucker, as the above species is styled, occurs in the Great Lakes and northwest to Alaska in clear, cold waters. It is very common in Lake Erie. It grows to a length of 2 feet and is

largest and most abundant northward, in Alaska reaching a weight of 5 pounds. As a food fish the Long-nosed Sucker is little esteemed; but in cold countries the head and roe are used in making a palatable soup.

The males in the breeding season, in spring, are profusely covered with tubercles on the head and fins and have a broad rosy band along the middle of the body. In the Yukon River, Alaska, Dr. Dall found the fish filled with spawn in April. The eggs are of moderate size and yellow in color. Nelson has seen this species seined by Eskimo in brackish estuaries of streams flowing into Kotzebue Sound. W. J. Fisher has collected specimens on the peninsula of Alaska.

This was not found in Cayuga Lake basin by Dr. Meek, but it occurs in the Adirondack region, and Dr. Meek believes it is a member of the Cayuga Lake fauna. Dr. Evermann obtained five specimens at Grenadier Island, N. Y., June 28, 1894.

The small race found by Fred Mather in the Adirondacks is the ordinary dwarf form characteristic of mountain regions. He discovered four individuals, only $4\frac{1}{4}$



LONG-NOSED SUCKER.

inches long, "but mature and breeding" in a little mountain brook emptying into Big Moose nearly north of the Big Moose Club House, by a bark shanty known as "Pancake Hall." The fish were spawning, and he discovered many eggs under the stones. The females were brown with white on belly, the male with red stripe on the side.

21. Common Sucker (*Catostomus commersonii* Lacépède).

Catostomus teres BEAN, Fishes Penna., 25, 1893.

Catostomus pallidus DEKAY, N. Y. Fauna, Fishes, 200, pl. 33, fig. 104, 1842.

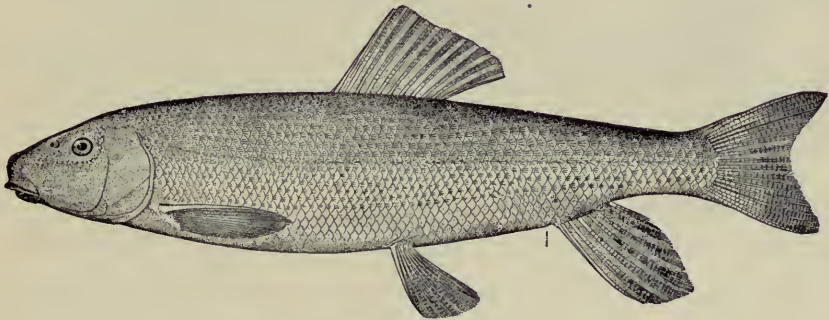
Catostomus commersonii JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 178, 1896, pl. 34, fig. 83, 1900.

The Common Sucker is also known as the Pale Sucker, White Sucker, Gray Sucker, Brook Sucker, and, among the Canadian French, as *carpe blanche*. It is the commonest member of its genus in waters east of the Rocky Mountains. It is

found from Canada to Florida and westward to Montana. Covering such a wide range of territory, the species is naturally variable, and has been described over and over again by many authorities under a great variety of names. The male of this sucker in spring has a faint rosy stripe along the middle of the side. The young are brownish in color and somewhat mottled and have a dark median band or a series of large blotches. The adults are light olive varying to paler and sometimes darker; sides silvery.

The species reaches a length of 22 inches, and a weight of 5 pounds. It is a very common inhabitant of ponds and streams of the lowlands, and a small race occurs in certain cold mountain streams in the Adirondack region, where it is dwarfed in size and changed in color, but does not differ in essential characters. Dr. Rothrock also obtained a mountain race of this sucker in Twin Lakes, Col., at an elevation of 9,500 feet above the sea level.

The Common Sucker is a very indifferent food fish in the estimation of most



COMMON SUCKER.

people, but, when taken from cold waters and in its best condition, its flesh is very palatable. It takes the hook readily when baited with common earth worms.

Dr. Richardson says:

“Its food consists chiefly of soft insects, but in one I found the fragments of a fresh-water shell. It is singularly tenacious of life, and may be frozen and thawed again without being killed.”

Dr. Meek found this species abundant throughout the entire Cayuga Lake basin, where it is known as the Common White Sucker.

Dr. Evermann in his catalogues of the fishes of Lake Ontario, taken in 1894, mentions this sucker from the following localities: Stony Creek, Black River, Mud Creek, Cape Vincent, mouth Salmon River, Chaumont River, creek at Pultneyville, mouth Little Salmon Creek, Sandy Creek, Long Pond, Stony Island, Lakeview Hotel, 7 miles northeast of Oswego, and Marsh Creek. In the St. Lawrence River basin he and Barton A. Bean obtained the young in Racket River, Norfolk, N. Y., July 18,

and in the St. Lawrence River, 3 miles below Ogdensburg, July 17. In the Lake Champlain basin these two collectors secured young and half grown specimens in the Saranac River, at Plattsburg, July 28, 1894.

The writer received specimens from Canandaigua Lake in November of 1896 and 1897, and seined the young in Bronx River in August, 1897. The small mountain form was secured from Saranac Lake in November, 1897. It is conspicuous for its small size and its red color. The Canandaigua lake suckers, received in November, 1896, thrive in captivity till July, 1897, when the warm water killed them.

Eugene Smith writes of this species :

"Color brownish, olivaceous above, silvery below ; the young are much blotched and marked on sides and back. It is occasionally caught on the hook. Young ones, in captivity, though they always grub about, and though they take food offered them, do not thrive and gradually starve. They remain wild and take alarm easily and often leap out of their tank. This species enters slightly brackish water."

22. Hog Sucker (*Catostomus nigricans* LeSueur).

Catostomus nigricans JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 130, 1883; BEAN, Fishes Penna., 26, pl. 21, fig. 31, 1893; DEKAY, N. Y. Fauna, Fishes, 202, 1842.

The Stone Roller has a wide distribution and a remarkable variety of common names. Among them are: Hammer Head, Stone Lugger, Stone Toter, Crawla-Bottom, Hog Molly, Hog Mullet, Mud Sucker, Hog Sucker, Banded Sucker, Large-scaled Sucker, and Black Sucker. The name Shoemaker was formerly applied to this species in Lake Erie, perhaps on account of the resemblance of its color to that of shoemaker's pitch.

Prof. Cope says that this species in Pennsylvania is most abundant in tributaries of the Ohio and in the Susquehanna, while in the Delaware it is uncommon. It ranges from Western New York to North Carolina and westward to Kansas. It is the most remarkable looking of all the suckers of New York, and may always easily be distinguished by the shape of its head. The species grows very large, reaching a length of 2 feet. It delights in rapid streams of cold clear water. Its habit is to rest quietly on the bottom, where its color protects it from observation. It is sometimes found in small schools. The spawning season is in spring, and the young are abundant in small creeks, as well as in the rivers. The food consists of insect larvæ and small shells, and it is specially fitted for securing its prey under stones in the rapids. As a food fish this sucker has little value.

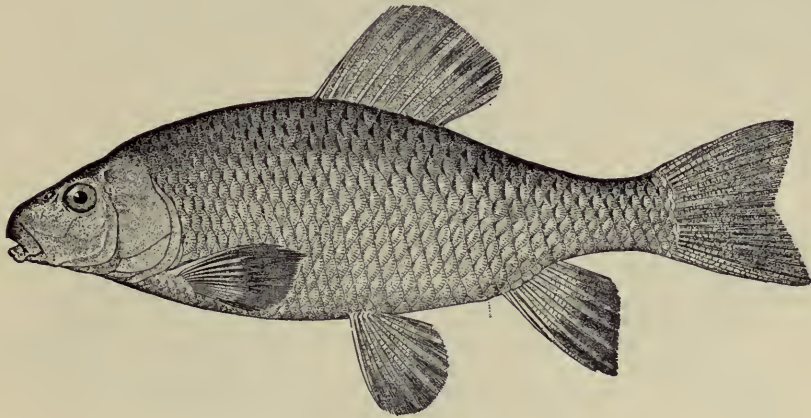
23. Chub Sucker (*Erimyzon sucetta* Lacépède).

Labeo gibbosus DEKAY, N. Y. Fauna, Fishes, 194, pl. 32, fig. 101, 1842.

Erimyzon sucetta BEAN, Fishes Penna., 27, 1893 (part).

The Chub Sucker here described is the southern form which was first made known by Lacépède from an individual received from Charleston, S. C. Jordan and Evermann now give the distribution of this form as extending from Virginia to Texas. It appears to reach a little farther northward if the references to DeKay are properly made. His *Labeo gibbosus* and *esopus* and the *Catostomus tuberculatus* seem to indicate the southern Chub Sucker.

The species reaches the length of 1 foot. It has very little value as food, but the



CHUB SUCKER.

young furnish excellent food for the larger fishes and are very interesting for aquarium purposes.

24. Chub Sucker (*Erimyzon sucetta oblongus* Mitchill).

Labeo elegans DEKAY, N. Y. Fauna, Fishes, 192, pl. 31, fig. 100, 1842.

Erimyzon sucetta JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 133, 1883; BEAN, Fishes Penna., 27, 1893 (part).

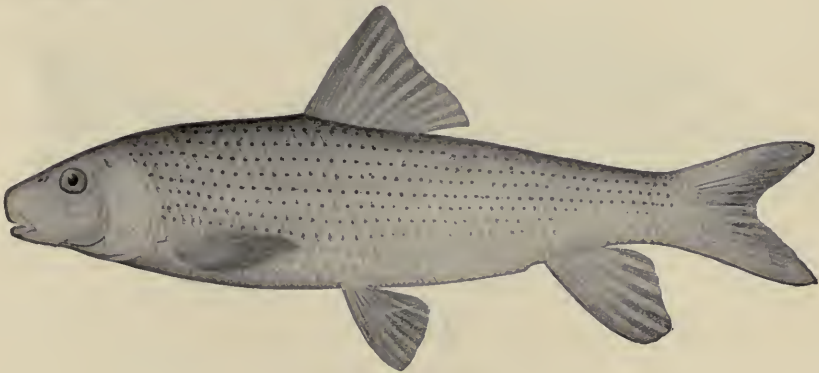
This is known as the Chub Sucker, Sweet Sucker, Rounded Sucker, Creek Fish, and Mullet. It has a wide range, practically including all the waters of the United States east of the Rocky Mountains.

The Chub Sucker grows to a length of about 1 foot. It is very tenacious of life and is a ready biter, but has little value for food. The young up to the length of several inches have a very distinct lateral band. They are often found in the shelter of water lilies and other aquatic plants close to brackish waters.

Dr. Evermann collected two specimens in Black Creek, tributary of Oswego River, at Scriba Corners, N. Y., July 17, 1894. Dr. Meek found it very common about Cayuga and Montezuma, N. Y., but did not observe it near Ithaca. In the market of New York, according to DeKay, the Chub Sucker makes its appearance in October, November and December. Specimens were seined in Bronx River in August, 1897.

A young example sent from near Princeton, N. J., by Prof. Ulric Dahlgren in September, 1897, showed the following voluntary change of color: When it arrived, it had the broad, longitudinal median band well developed and the vertical bands obsolete; but soon after it was placed in a tank it obscured the longitudinal band entirely and developed the vertical bands.

The food of the Chub Sucker consists chiefly of minute crustaceans, insect larvæ and aquatic plants.



STRIPED SUCKER.

25. Striped Sucker (*Minytrema melanops* Rafinesque).

Minytrema melanops JORDAN, Bull. 12, U. S. Nat. Mus. 138, 1878; BEAN, Fishes Penna., 28, pl. 21, fig. 32, 1893.

The Striped Sucker, also called Soft Sucker, Sand Sucker, and Black-nosed Sucker, is found in the Great Lakes and south to South Carolina and Texas. In Pennsylvania it is limited to Lake Erie and the Ohio Valley. In New York it is to be expected in Lake Ontario and its tributaries, and should also occur in Chautauqua Lake.

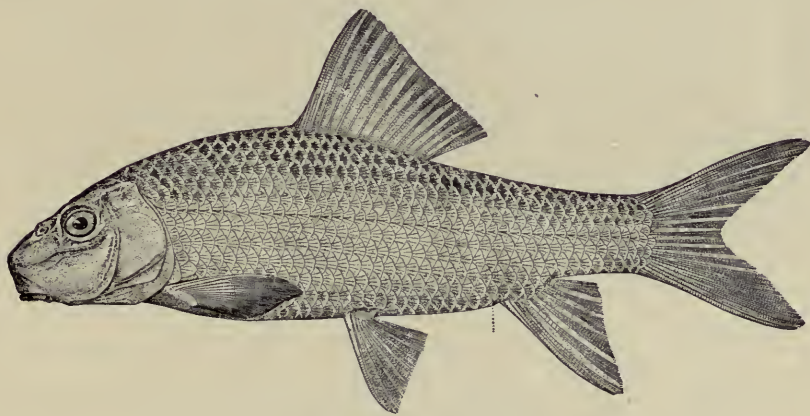
The Striped Sucker grows to a length of 18 inches. Old males have the head tuberculate in the breeding season in the spring. The species is very readily distinguished by the dark stripes along the sides produced by spots at the base of each scale. In the young of this sucker there is no lateral line but in adults it is almost entire. This sucker prefers clear, sluggish waters and grassy ponds. It

readily adapts itself to life in the aquarium. It feeds entirely on mollusks, insects and insect larvæ. The species is not much esteemed as a food fish, though it is sold in large numbers.

Minytrema melanops is normally without a lateral line, but this feature is occasionally partially developed and has caused some confusion in assigning certain individuals to their proper genus; indeed, one author has described and figured the Striped Sucker as two species, belonging to two different genera, having been misled by this undeveloped character.

26. White-nosed Sucker (*Moxostoma anisurum* Rafinesque).

Moxostoma anisurum JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 141, 1883; BEAN, Fishes Penna., 28, 1893; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 190, 1896.



WHITE-NOSED SUCKER.

The White-nosed Sucker is found sparingly in the Ohio River and the Great Lakes region; widely distributed, but nowhere abundant. Cuvier and Valenciennes received from Milbert a specimen sent from Lake Ontario, measuring about 2 feet. Dr. Jordan says this is very closely related to the common Red Horse, from which it can hardly be distinguished except by its fins. Dr. Evermann collected a single specimen at Fox Island, N. Y., June 29, 1894; he also obtained a specimen 12 inches long at Point Breeze, N. Y., August 21, 1894, which he refers to this species, though indicating some characters in which it differs from the normal form of the White-nosed Sucker.

27. Red Horse (*Moxostoma aureolum* LeSueur).

Catostomus aureolus DEKAY, N. Y. Fauna, Fishes, 201, pl. 42, fig. 133, 1842.

Moxostoma aureolum JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 140, 1883; BEAN, Fishes Penna., 30, 1893; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 192, 1896.

The Red Horse has the additional names of Golden Red Horse, Golden Sucker, Mullet, Golden Mullet, and Lake Mullet. It inhabits the Great Lakes and the region northward, also the Ohio Valley. It is common in Lake Erie, but not in Ohio.

This species grows to a length of 18 inches and is one of the handsomest of the suckers. Prof. Forbes records it from lakes of Northern Illinois, also abundantly in the central part of that State.

Dr. Evermann, in collecting fishes of the Lake Ontario region, secured it at the following localities: Lake Ontario, 4 miles off Nine Mile Point, N. Y., June 12, 1893; Lake Shore, 3 miles west of Oswego, July 17, 1894; mouth Salmon River, July 25, 1894; Long Pond, Charlotte, N. Y., Aug. 17, 1894; Sandy Creek, North Hamlin, N. Y., August 20, 1894.

Dr. Meek identified a single specimen of the so-called Common Red Horse of Cayuga Lake with *Moxostoma macrolepidotum*, and stated, on the authority of Mr. Kipp, that it is common at the northern end. Jordan & Evermann, however, do not extend the range of *macrolepidotum* so far north, and it is probable that the common *Moxostoma* of Cayuga Lake is *M. aureolum*.

DeKay records the species as very common in Lake Erie. In August and September he observed them to be full of worms. In his New York Fauna, Fishes, p. 198, he describes a sucker or mullet under the name Oneida Sucker. This he stated is common in Oneida Lake. The species is considered identical with *Moxostoma aureolum*. His description shows a very close agreement with that of *aureolum*.

The food of the Red Horse consists chiefly of mollusks and insects. It is not a choice food fish.

Eugene Smith records this form as occurring in the vicinity of New York City. Mention has already been made of the doubt concerning the northern limits of the range of *macrolepidotum*; but for the sake of comparison the brief description of *macrolepidotum* published by Jordan & Evermann is given herewith.

Head moderate, rather stout, its length four and three-fifths in body; eye one and two-thirds in snout; dorsal fin with its free edge concave; scales usually with dusky shade at base; lower fins pale. Streams about Chesapeake and Delaware

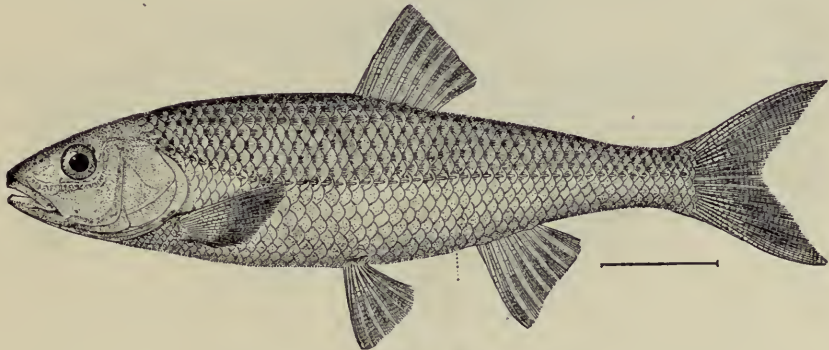
Bays and southward to North Carolina. It seems in some respects intermediate between *M. aureolum* and *M. crassilabre*; we cannot at present identify it with either.

28. Fallfish (*Semotilus bullaris* Rafinesque).

Semotilus bullaris JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 222, 1883; BEAN, Fishes Penna., 50, pl. 24, fig. 41, 1893.

Leuciscus nitidus DEKAY, N. Y. Fauna, Fishes, 209, pl. 33, fig. 105, 1842, Lake Champlain.

The Fallfish or Dace is one of the largest of the minnow family in New York, reaching a length of 18 inches, and it is one of the most beautiful species as well as game in its qualities. As a food fish, however, this is not greatly esteemed. It is extremely common in the Delaware River and its tributaries and moderately abundant in the Susquehanna. The Fallfish is found from Quebec to Virginia. Mitchell



FALLFISH.

had it from the Wallkill River and knew of its occurrence in the Hudson, near Albany. Rafinesque recorded it from the Fishkill and other tributaries of the Hudson. DeKay knew it from Lake Champlain and from New York Harbor. Evermann and Bean collected it in Scioto Creek, at Coopersville, and in Saranac River, at Plattsburg, in July, 1894; also in Racket River, at Norfolk, and the St. Lawrence River, 3 miles below Ogdensburg, in the same month.

In the Lake Ontario basin the U. S. Fish Commission parties found it at Sacket Harbor, Centerville, Watertown, Oswego, Webster, Charlotte, Belleville, Henderson Bay, Henderson Harbor, and Salt Brook, near Nine Mile Point.

The Fallfish delights in rapid, rocky portions of large streams and in the deep channels. On being hooked it fights desperately for a short time, but its resistance is soon overcome. Thoreau describes it as a soft fish with a taste like brown paper salted, yet the boy fishermen will continue to covet and admire this handsome and

ubiquitous representative of the minnow family. A colored plate of the fish, natural size, appears in the Third Annual Report of the Commissioners of Fisheries, Game and Forest of the State of New York, 1898, facing page 146. There is also a good account of the fish by A. N. Cheney on pages 244 and 245 of the same report.

29. **Horned Dace** (*Semotilus atromaculatus* Mitchill).

Leuciscus atromaculatus DEKAY, N. Y. Fauna, Fishes, 210, pl. 32, fig. 102, 1842.

Semotilus atromaculatus BEAN, Fishes Penna., 51, 1893; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 222, 1896; pl. XL, fig. 100, 1900.

The Common Chub, Creek Club, smaller Fallfish or Horned Dace has a wider distribution than *S. bullaris*, but it does not grow quite so large, seldom exceeding 1 foot in length. Its range extends from New England to Missouri, southward to Georgia and Alabama. It is extremely common and ascends the small streams.



HORNED DACE.

The U. S. Fish Commission collectors in 1894 took numerous specimens at the following localities: Sacket's Harbor, July 2; Centerville, July 24; Watertown, July 5; Oswego, July 25; Webster, August 9; Charlotte, August 17; Belleville, July 12; Henderson Bay, July 4; Henderson Harbor, July 3; and Salt Brook, 1½ miles above Nine Mile Point, June 10 and 11, 1893.

Dr. Meek reported it as abundant throughout the Cayuga Lake basin. Large examples are found in Canandaigua Lake. One of them measured 14 inches in July, 1897. The fish is killed by warm water. The food in captivity includes hard clams, earthworms, and, occasionally, live killifish.

A. N. Cheney refers to this species on page 245 of the Third Annual Report of the Commissioners of Fisheries, Game and Forest of the State of New York.

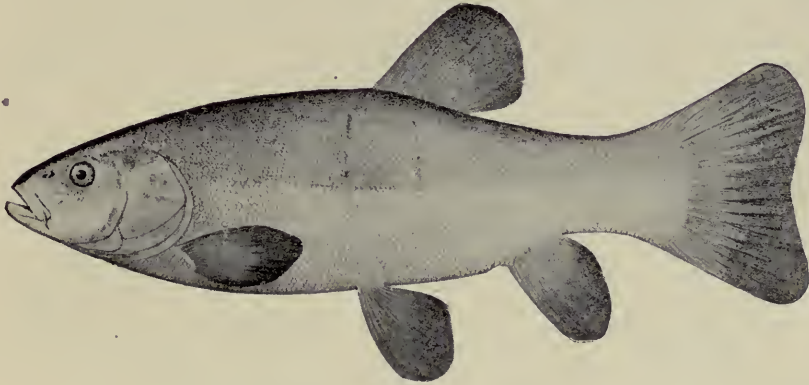
In Pennsylvania it is the commonest minnow in the Alleghany and Susquehanna basins and is sufficiently common in the Delaware. According to Prof. Cope it reached 4 pounds in weight and is a fair food fish.

This species is more characteristic of the small streams and clear ponds and it takes the hook very freely ; but its proper mission is to serve as bait for the larger and choicer fishes.

30. **Tench** (*Tinca tinca* Linnæus).

Tinca vulgaris CUVIER & VALENCIENNES, Hist. Nat. Poiss, XVI, 322, pl. 484, 1842 ;
HECKEL & KNER, Süßw. Fische, 75, fig. 34, 1858.

The Tench has been introduced into the United States. An individual taken in the Potomac River near Washington, D. C., has a grinding surface well developed on the pharyngeal teeth, a character concerning which no mention is made in the current descriptions. The Tench now extends throughout the fresh waters of



TENCH.

Europe into those of Asia Minor. Its northern limit is said to be in Finland. It may or may not be native to England. The species prefers still waters in which aquatic plants abound. It is very tenacious of life and has been observed to live a whole day out of water. Its food consists of insects, larvæ, worms and vegetable substances.

Spawning takes place in June and July. The eggs are small and adhesive. The rate of growth is rather rapid under favorable circumstances, the young having attained to a weight of 1 pound in their first year. Individuals of the weight of 10 or 11 pounds are recorded, and Salvianus mentioned a Tench of 20 pounds. As for the quality of its flesh opinions differ, some persons considering it unpalatable, while others regard it as delicious and wholesome.

31. Lake Minnow (*Hybopsis storerianus* Kirtland).

Ceratichtys lucens JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 213, 1883.

Leuciscus storerianus KIRTLAND, Bost. Jour. Nat. Hist., V, 30, pl. 9, fig. 2, 1847.

Kirtland found the Lake Minnow only in Lake Erie, where it was frequently taken with seines in fishing for other species. The U. S. Fish Commission recently added it to the fauna of the Lake Ontario basin, three specimens having been collected in Long Pond, Charlotte, August 17, 1894.

32. Horned Chub (*Hybopsis kentuckiensis* Rafinesque.)

Leuciscus biguttatus DEKAY, N. Y. Fauna, Fishes, 214 (extra-limital), 1842.

Hybopsis kentuckiensis BEAN, Fishes Penna., 49, pl. 24, fig. 40, 1893.

Rafinesque states that the fish is known as Indian Chub, Redtail and Shiner. Other names in eastern localities are Nigger Chub, River Chub, Jerker, Horned Dace and Horny-head.

The species ranges from Pennsylvania westward to Dakota and south to Alabama. In Pennsylvania it is common in the Susquehanna and the Ohio basin, but absent from the Delaware. Dr. Meek collected a few specimens at Montezuma, N. Y., and found none in any of the other localities investigated. Eugene Smith refers to this species two specimens of fish from the Passaic River. The flesh of his fish appeared to be very soft.

The Horned Chub abounds in large rivers and is rarely seen in small brooks. This minnow grows to a length of 10 inches and is good for food. As a bait for the Black Bass, because of its endurance on a hook, it cannot be excelled.

33. Cut-lips (*Exoglossum maxilllingua* LeSueur).

Exoglossum maxilllingua JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 160, 1883; BEAN, Fishes Penna., 36, pl. 22, fig. 36, 1893; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 327, 1896, pl. LIV, fig. 14a, 1900, head below.

The Cut-lips may be readily distinguished by the three-lobed lower jaw, the dentary bones being closely united and the lower lip represented by a fleshy lobe on each side of the mandible.

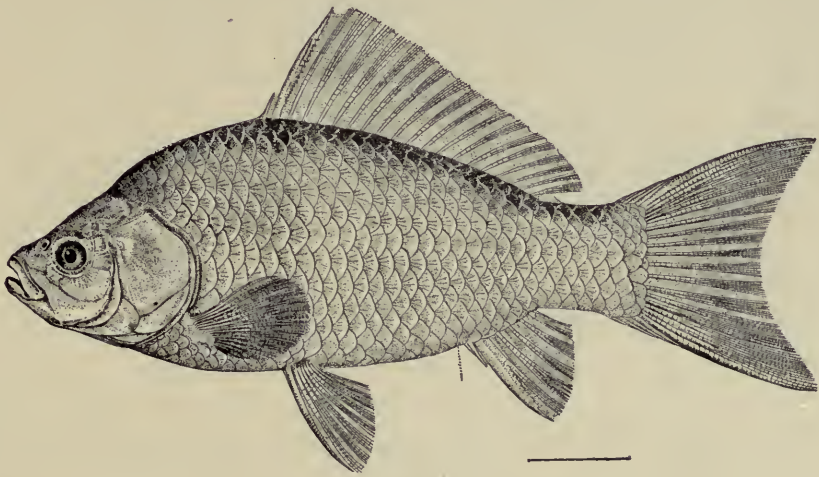
The Cut-lip is known as Chub, Butter Chub, Nigger Chub and Day Chub. It is a very common species in the Susquehanna and its tributaries. Its range is not extensive, reaching only from Western New York to Virginia. In New York it occurs in Lake Ontario, the St. Lawrence, Lake Champlain, Cayuga Lake and the

Hudson River. The U. S. Fish Commission has it from the following New York localities in the Lake Ontario basin: Mouth Salmon River, Selkirk; Big Sandy Creek, Belleville; Wart Creek, Buena Vista; Little Stony Creek, Henderson Bay; Big Stony Creek, Henderson Harbor; Spring Brook, Pulaski; Black River, Huntingtonville.

All of these were obtained in July, 1894. Evermann and Bean collected it also in the St. Lawrence, 3 miles below Ogdensburg, July 17, 1894, and Scioto Creek, Coopersville and Saranac River, Plattsburg, July 19, 1894.

Dr. Meek found it in small numbers in Six Mile Creek and Fall Creek, below the falls. It inhabits clear running water.

The fish grows to the length of 6 inches and may be at once distinguished from all of the other minnows by its three-lobed lower jaw. It is believed that this



GOLDFISH.

singular structure of the mouth enables the fish to scrape mollusks from their hold on rocks, as its stomach usually contains small shellfish. It takes the hook readily.

34. Goldfish (*Carassius auratus* Linnæus).

Cyprinus auratus DEKAY, N. Y. Fauna, Fishes, 190, 1842.

Carassius auratus JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 253, 1883; BEAN, Fishes Penna., 54, pl. 25, fig. 43, 1893.

The common Goldfish or Silverfish is a native of Asia, whence it was introduced into Europe and from there into America, where it is now one of the commonest aquarium fishes and is extremely abundant in many of our streams. In Pennsylvania it abounds in the Delaware and Schuylkill Rivers.

DeKay made the following remarks about the Goldfish, or Golden Carp, as he styled it:

"The Golden Carp, or Goldfish, as it is more generally called, was introduced from China into Europe in the early part of the 17th century, and probably shortly after found its way to this country. They breed freely in ponds in this and the adjoining States. They are of no use as an article of food, but are kept in glass vases as an ornament to the parlor or drawing room. They are said to display an attachment to their owners and a limited obedience to their commands."

They are introduced into lakes, ponds, fountains and reservoirs generally. An individual was kept in a fountain at 42d Street and 5th Avenue, New York, by Patrick Walsh nine years and was then presented to the aquarium.

At Cold Spring Harbor Hatchery, L. I., several varieties were hatched from the same lot of eggs. These included the normal form, the typical fan-tail, and one which was so deep bodied that it could scarcely balance itself in swimming.

The Goldfish in the New York Aquarium were never troubled by fungus parasites.

"In many of our streams and ponds, the Goldfish has run wild, and hundreds of the olivaceous type will be secured to one of a red color. In the fauna of the moraine ponds and in quarry holes, the Goldfish stands first. It will breed in foul water where only Catfish and Dogfish (*Umbra*) can be found." *Eugene Smith.*

The Goldfish is extremely variable in color and form. It is usually orange, or mottled with black and orange, yet in some streams and even in pond culture, silvery individuals are often more common than any of the mottled varieties. The species grows to the length of 12 inches. It spawns early in the spring and is subject to many dangers and is attacked by many enemies. The fish, however, is extremely hardy, prolific, and tenacious of life.

35. Carp (*Cyprinus carpio* Linnæus).

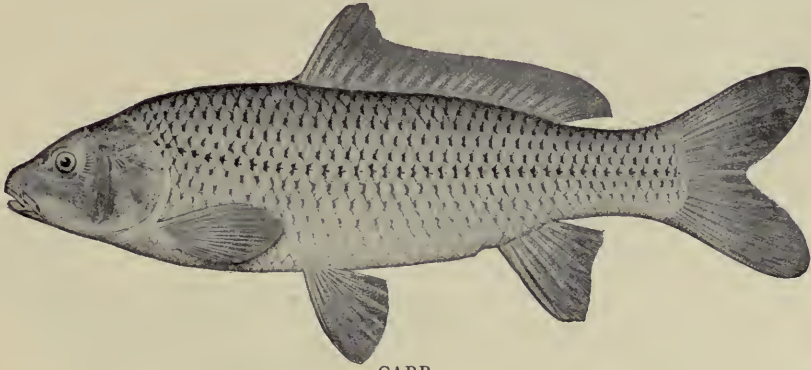
Cyprinus carpio DEKAY, N. Y. Fauna, Fishes, 188, 1842; JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 254, 1883; BEAN, Fishes Penna., 55, pl. 1, colored, 1893.

The Carp is a native of Asia and has been introduced into Europe and America as a food fish, chiefly for pond culture. It thrives in all warm and temperate parts of the United States, and reaches its best condition in open waters. In Texas it has grown to a length of 23 inches in 11 months after planting. The leather variety is most hardy for transportation. Mr. Hessel has taken the Carp in the Black and Caspian Seas; salt water seems not to be objectionable to it, and it will live in stagnant pools, though its flesh will be decidedly inferior in such waters. The Carp

hibernates in winter except in warm latitudes, takes no food and does not grow ; its increase in size in temperate latitudes occurs only from May to August.

The spawning season begins in May and continues in some localities till August. A Carp weighing 4 to 5 pounds, according to Mr. Hessel, yields from 400,000 to 500,000 eggs ; the Scale Carp contains rather more than the other varieties. During the spawning the fish frequently rise to the surface, the female accompanied by two or three males. The female drops the eggs at intervals during a period of some days or weeks in shallow water on aquatic plants. The eggs adhere in lumps to plants, twigs and stones. The hatching period varies from 12 to 16 days.

According to Hessel the average weight of a Carp at 3 years is from 3 to $3\frac{1}{2}$ pounds ; with abundance of food it will increase more rapidly in weight. The Carp continues to add to its circumference till its thirty-fifth year, and in the southern parts of Europe Mr. Hessel has seen individuals weighing 40 pounds and measuring



CARP.

$3\frac{1}{2}$ feet in length and $2\frac{3}{4}$ feet in circumference. A carp weighing 67 pounds and with scales $2\frac{1}{2}$ inches in diameter was killed in the Danube in 1853. There is a record of a giant specimen of 90 pounds from Lake Zug, in Switzerland. Examples weighing 24 pounds have been caught recently in the Potomac River at Washington, D. C.

The Carp lives principally on vegetable food, preferably the seeds of water plants such as the water lilies, wild rice and water oats. It will eat lettuce, cabbage soaked barley, wheat, rice, corn, insects and their larvæ, worms and meats of various kinds. It can readily be caught with dough, grains of barley or wheat, worms, maggots, wasp larvæ and sometimes with pieces of beef or fish.

During the summer of 1897 two female Leather Carp died in captivity as a result, of retention of the eggs.

Large individuals are found in Prospect Park Lake, Brooklyn, where the species was introduced. The food of the fish in captivity includes hard clams, earthworms,

wheat, corn, lettuce and cabbage. Its growth is remarkable. A Leather Carp has fully doubled its weight in one year.

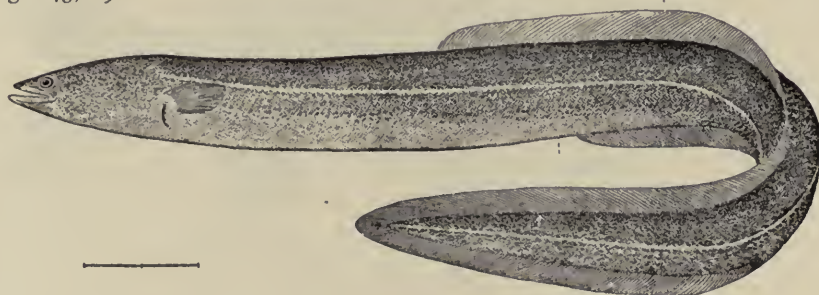
Linnaeus says the Carp was introduced into England about the year 1600. DeKay places the first introduction into New York waters in the year 1831, and publishes a letter of Henry Robinson, Newburgh, Orange Co., who brought them from France, reared and bred them successfully in his ponds, and planted from one dozen to two dozen at a time in the Hudson during the four years preceding his letter. Mr. Robinson stated that they increased greatly and were frequently taken by fishermen in their nets.

36. Eel (*Anguilla chrysypa* Rafinesque).

Anguilla chrysypa RAFINESQUE, Amer. Month. Mag., II, 120, Dec., 1817.

Anguilla tenuirostris DEKAY, N. Y. Fauna, Fishes, 310, pl. 53, fig. 173, 1842; BEAN, Fishes Penna., 95, pl. 30, fig. 58, 1893.

Anguilla chrysypa JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 348 1896, pl. LV, fig. 143, 1900.



EEL.

The Eel appears to have only one common name. It is one of the best known and most singular of our fishes, yet its breeding habits have only recently been observed. The species ascends the rivers of Eastern North America from the Gulf of St. Lawrence to Mexico, the former being the northern limit of the species on our coast. In the Ohio and Mississippi valleys it is extremely common and its range has been much extended by the opening of canals and by artificial introduction. It has been transferred to the Pacific coast.

The Eel has been known to exceed a length of 4 feet. The average length of individuals, however, is about 2 feet. The female is larger than the male, paler in color, and is different in certain other particulars, which are mentioned in the descriptions of the species.

This is a very important food fish. It is caught chiefly when descending the rivers in the fall. In 1869 about a ton of eels were caught in a single fish basket

above Harrisburg. At the present time this method of capture is illegal. Both adults and young eels ascend the streams in spring, the young coming in millions, but in the fall run small eels are seldom seen. Till a comparatively recent date it was not certainly known that the eels have eggs which are developed outside of the body. Even now the breeding habits are scarcely known, but it is supposed that spawning takes place late in the fall or during the winter near the mouths of rivers, on muddy bottoms. Dr. Jordan has expressed the belief that the eel sometimes breeds in fresh water, since he has found young eels less than an inch long in the headwaters of the Alabama River, about 500 miles from the sea. It is estimated that a large eel contains about 9,000,000 eggs. The eggs are very small, measuring about 80 to an inch, and can scarcely be seen by the naked eye.

The difference of size in the sexes has already been referred to. According to one writer the males are much smaller than the females, rarely exceeding 15 or 16 inches in length. The question whether eels will breed in fresh water has an important bearing on their introduction into places from which they cannot reach the sea. The generally accepted belief is that, while the eels will grow large and fat, they will not reproduce under such circumstances.

When the eels meet obstructions in streams they will leave the water and travel through wet grass or over moist rocks. They have not been able to surmount the Falls of Niagara. At the foot of this barrier hundreds of wagon loads of young eels have been seen crawling over the rocks in their efforts to reach the upper waters.

Dr. Mitchill heard of an eel which was caught in one of the south bays of Long Island that weighed 16½ pounds. He records the use of eelpots and the practice of bobbing, and also the winter fishing by spearing. Dr. Mitchill states distinctly that the ovaries of eels may be seen like those of other fish, but they are often mistaken for masses of fat. Dr. DeKay states that he had examined the silver eel of the fishermen and was disposed to consider it only a variety of the common eel. He characterizes it as "silvery gray above, with clear, satiny white abdomen, separated from the color above by the lateral line."

In captivity eels live many years. They delight to lie buried in the mud or sand with only their heads out, ready for anything edible to come within reach. Mussels and snails are picked out of the shells by them. (After Eugene Smith, Proc. Linn. Soc. N. Y. No. 9, p. 29, 1897.)

The eel in captivity is particularly liable to attacks of fungus, which do not always yield to treatment with salt or brackish water; but the parasite can be overcome by placing the eel in a poorly lighted tank.

In Cayuga Lake, N. Y., according to Dr. Meek, the eel is not common, but is occasionally taken at the end of the lake.

W. H. Ballou makes the following remarks about the feeding habits:

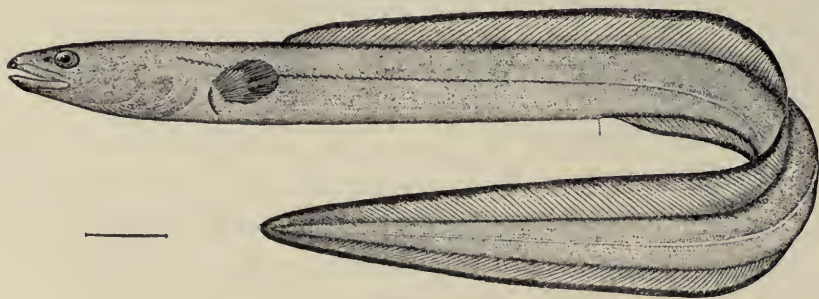
"They are among the most voracious and carnivorous fishes. They eat most inland fishes except the gar and the chub. They are particularly fond of game fishes, and show the delicate taste of a connoisseur in their selections from choice trout, bass, pickerel and shad. On their hunting excursions they overturn huge and small stones alike, working for hours if necessary, beneath which they find species of shrimp and crayfish, of which they are exceedingly fond. They are among the most powerful and rapid of swimmers. They attack the spawn of other fishes open-mouthed, and are even said to suck the eggs from an impaled female. They are owl-like in their habits, committing their depredations at night."

37. Conger (*Leptocephalus conger* Linnæus).

Muræna conger LINNÆUS, Syst. Nat., ed. X, I, 245, 1758.

Conger occidentalis DEKAY, N. Y. Fauna, Fishes, 314, pl. 53, fig. 172, 1842, very poor.

Leptocephalus conger GOODE, Fish & Fish. Ind. U. S., I, pl. 240, 1884; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 354, 1896, pl. VII, fig. 148, 1900.



CONGER.

The Conger Eel occurs on both coasts of the Atlantic, on our coast extending from Cape Cod to Brazil, but often coming into shallow bays. An exception is noted in Great Egg Harbor Bay, where the fish is not rare in summer. It is sometimes caught in Gravesend Bay also in summer, and occasional individuals are captured on hand lines off Southampton, L. I., by men fishing for sea bass and scup. The fishermen dislike to handle the species on account of its pugnacity and strength; it snaps viciously at everything near it when captured in our waters; yet, strangely enough, the writer has seen a hundred or more taken on trawl lines off the north coast of France, in a boat at one time, and not one gave evidence of ferocity.

In captivity in the aquarium the sea eel suffers severely from fungus attacks,

which are not relieved by changing the fish from salt water to fresh. Perhaps the salinity of the water in some localities is too low, and relief might be obtained by supplying sea water of normal ocean density.

The young and larval form of the Conger is a curious, elongate, transparent, band-like creature with a minute head, a very small mouth and with the lateral line, belly, and anal fin dotted with black points.

An individual nearly 3 feet long was captured with a hand line by A. P. Latto in the ocean, near Southampton, L. I., August 3, 1898, while fishing for sea bass and scup.

In the Woods Hole region, according to Dr. Smith, "it comes in July and remains until fall; very common for several years, but rather rare formerly. Fishermen as a rule do not distinguish it from the common eel. A few are taken in traps and with lines, but many large ones, weighing from 8 pounds upwards, are caught in lobster pots. A specimen in the collection weighs 10 pounds. One caught on a line at Falmouth, August 30, 1897, weighed 12 pounds. The smallest observed are 15 to 20 inches long."

Mitchill declared the flesh to be very dainty eating. DeKay said the flesh has a peculiar unsavory taste. He discovered that it is a vicious animal, snapping when captured at everything near it. In France the Conger Eel is among the cheapest and least esteemed of the food fishes.

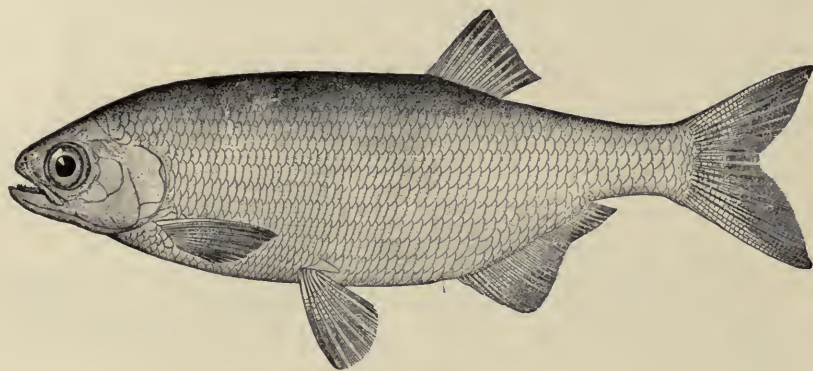
The observations of Dr. Otto Hermes, Director of the Berlin Aquarium, on the habits and the reproduction of the Conger Eel are of very great interest. Reference is made to them by Goode in *Fish and Fishery Industries of United States*, I, p. 657, and two figures copied from drawings of Dr. Hermes are given in the text. The ovary of the Conger, says Dr. Hermes, is developed in captivity, and this is often the cause of the death of the eel. In a Conger which died in the Berlin Aquarium the ovaries protruded very extensively, and a specimen in the Frankfort Aquarium burst on account of the extraordinary development of the ovaries. The ovaries of this eel, which weighed $22\frac{1}{2}$ pounds, themselves weighed 8 pounds, and the number of eggs was about 3,300,000. The want of a natural opening for the escape of the eggs was evidently in this case the cause of death. In the fall of 1879 Dr. Hermes received a number of small sea eels taken in the vicinity of Havre. These eels ate greedily and grew rapidly. Only one was tardy in its development, so that it could easily be distinguished from the rest. This one died June 20, 1880, and was examined the same day. It proved to be a sexually mature male and served to clear up some very doubtful problems in the reproduction of the species, as well as its ally, the Common Eel.

38. Moon-eye (*Hiodon tergisus* LeSueur).

Hiodon tergisus DEKAY, N. Y. Fauna, Fishes, 265, pl. 41, fig. 130 ; JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 260, 1883.

Hiodon tergisus BEAN, Fishes Penna., 57, pl. 25, fig. 44 (named *alosoides*), 1893 ; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 413, 1896, pl. LXVIII, fig. 180, 1900.

This species is called Moon-eye, Toothed Herring, and Silver Bass. It is found in Canada, the Great Lakes region and the upper part of the Mississippi Valley, being very common in large streams and lakes. It abounds in Lake Erie and the Ohio and is seined in large numbers. DeKay observed the fish in the Alleghany River, N. Y. He recorded it also from Buffalo and Barcelona, on Lake Erie, at which places it is known as Moon-eye, Shiner and Lake Herring. He says it is very indifferent food.



MOON-EYE.

This species grows to a length of 1 foot and, like the other, though a beautiful fish and possessed of excellent game qualities, its flesh is full of small bones. It is a good fish for the aquarium ; it will take a minnow or the artificial fly very readily, and the utmost skill is required in its capture. Its food consists of insects, small fishes and crustaceans.

Dr. Richardson describes this fish as a member of the minnow family, which, he says, is known to the Canadians under the name La Quesche. The fish is described as having the back brilliant green, sides and abdomen with a silvery luster. The specimens which were taken in the Richelieu, where it falls into the St. Lawrence, were about 9 or 10 inches long.

39. Northern Moon-eye (*Hiodon alosoides* Rafinesque).

Hiodon alosoides JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 259, 1883.

Hiodon alosoides BEAN, Fishes Penna., 57, 1893 (not figure); JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 413, 1896.

Hiodon clodalis DEKAY, N. Y. Fauna, Fishes, pl. 51, fig. 164, not description, 1842.

The Northern Moon-eye is found from the Ohio River throughout the Great Lakes region to the Saskatchewan. It is very common in Manitoba and other parts of British America. In Pennsylvania it is limited to the western region.

DeKay must have had the Northern Moon-eye for study, though his description seems to apply to another species. The figure of his *Hiodon clodalis* represents a fish with a short dorsal fin, quite unlike his account in the text.

The Northern Moon-eye is very readily distinguished from the other species of the genus by its short dorsal fin, which contains only nine rays, and by its carinated belly. It grows to the length of 1 foot. The flesh is not greatly esteemed as a rule, but the fish is beautiful and has excellent game qualities.

Richardson says the fish inhabits lakes which communicate with the Saskatchewan, in the 53d and 54th parallels of latitude, but does not approach nearer to Hudson's Bay than Lake Winnipeg. This we know to be a mistake. He says further that it is taken during the summer months only, and in small numbers, in gill nets set for other fish. It bites eagerly at an artificial fly or worm. Its flesh is white, resembling that of the perch in flavor, and excelling it in richness.

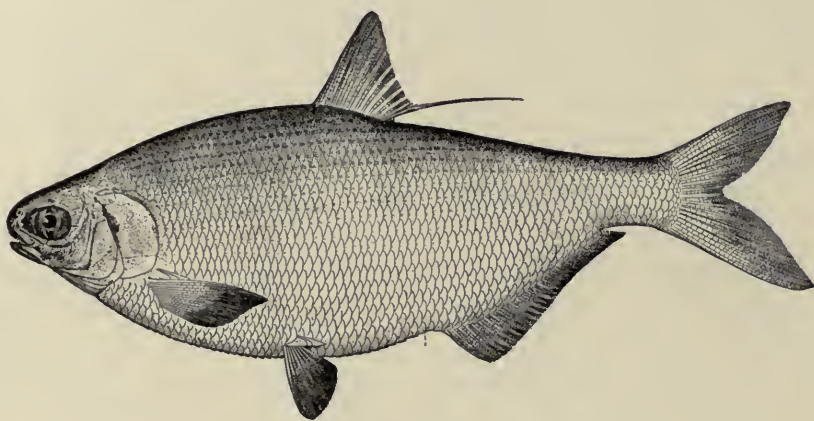
40. Gizzard Shad (*Dorosoma cepedianum* LeSueur).

Dorosoma cepedianum JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 271, 1883; GOODE, Fish & Fish. Ind. U. S., I, 610, pl. 217 A, 1884; BEAN, Fishes Penna., 63, 1893; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 416, 1896, pl. LXIX, fig. 183, 1900.

The Mud Shad, also known as Gizzard Shad, Winter Shad, Stink Shad, White-eyed Shad, Hickory Shad, Hairy Back and Thread Herring, is found in brackish waters along the coast from New York southward to Mexico, ascending streams and frequently becoming landlocked in ponds. A variety of this fish is also common in the Ohio and Mississippi valleys, whence it has spread through canals into Lakes Erie and Michigan.

Cuvier and Valenciennes had the species from New York, whence it was sent by Milbert. DeKay mentions it only as an extralimital fish, but in his time the fish fauna of Lake Erie was very little known.

This fish grows to a length of 15 inches and a weight of 2 pounds. It spawns in summer, and its food consists of algæ, confervæ, desmids and diatoms. With its food it takes large quantities of mud, from which it separates the organic substances after swallowing. This is a beautiful species, somewhat resembling the shad in general appearance, and has been very successfully kept in the aquarium where its bright colors and graceful movements make it attractive; but its flesh is soft, tasteless and seldom eaten when any better can be obtained. In most regions fishermen consider it a great nuisance and throw away their entire catch. Negroes eat the mud shad from tributaries of the Chesapeake, and in Florida the fish has been utilized to some extent in making guano. The name Gizzard Shad alludes to the form of the stomach, which is very much like that of a hen.



GIZZARD SHAD.

41. Sea Herring (*Clupea harengus* Linnæus).

Clupea harengus JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus. 265, 1883; BEAN, 19th Rept. N. Y. Comm. Fish., separate, 42, pl. XXIV, fig. 32, 1890.
Clupea elongata DEKAY, N. Y. Fauna, Fishes, 250, 1842.

The Sea Herring is the most important food fish of the world and it is undoubtedly the most abundant of all the fishes. Its food consists of small invertebrates, chiefly copepods and the larvæ of worms and mollusks. It forms the most important food of many of our valuable food fishes, including the cod, haddock, halibut, bluefish, and a great many others. Herring spawn at two seasons, spring and fall, the first spawning continuing from April to June and the second season between July and December. The eggs are adhesive and are deposited on the bottom, where they adhere to seaweeds and other objects of support. The egg is about $\frac{1}{20}$ inch in diameter. The hatching period lasts from 12 to 40 days, according to the temperature of the water. Sea Herrings were artificially hatched as early

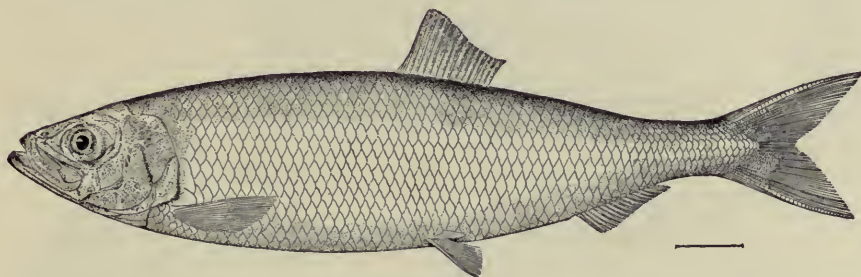
as 1878, both in Germany and the United States. It has been estimated that the annual yield of Sea Herring is 3,000,000,000 fish, principally taken in Norway.

The Herring occurs on our east coast from Labrador to New York. When found as far south as New York, it usually occurs in midwinter. Capt. Thurber obtained it in Great South Bay in the fall.

The young of the Sea Herring is well known as the whitebait of England and the United States, though in the latter country the young of other species are sometimes mingled with those of the Sea Herring.

Many young, translucent fish of the genus *Clupea*, a little under 2 inches long, are seen in spring in the shad fykes and pounds of Gravesend Bay. They are called "shad bait," because they are said to be taken frequently from shad stomachs.

Large Sea Herring, according to W. I. DeNyse, are rare in Gravesend Bay. Only about 100 or 200 are obtained there during fall and winter.



SEA HERRING.

Young examples, from $4\frac{3}{4}$ to 6 inches long were obtained in the bay November 23, 1897.

In the vicinity of Woods Hole, Mass., according to Dr. Smith, "schools of large herring in spawning condition appear about October 15, and remain till very cold weather sets in, their departure corresponding with that of the cod. By January young herring $\frac{1}{4}$ inch long are taken in surface tow nets; by May 1, they are 1 to $1\frac{1}{4}$ inches long, and by August 1, $2\frac{1}{2}$ to 3 inches. Fish 3 to 5 inches long, called "sperling" are found from September 1 to end of the season and are used for mackerel bait. About June 1, there is a large run of herring, smaller than those in the fall run. This lasts two weeks, during which time the traps are full of them. No use is made of the early run, but in fall they are caught in gill nets for food and bait."

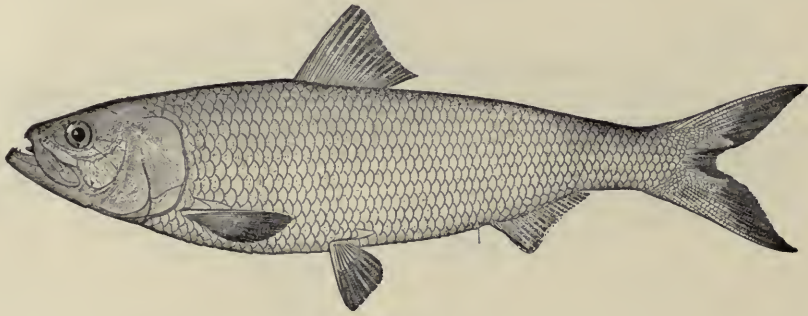
42. Skipjack (*Pomolobus chrysochloris* Rafinesque).

Pomolobus chrysochloris JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 425, 1896, pl. LXX, fig. 187, 1900.

Clupea chrysochloris JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus. 266, 1883; BEAN, Fishes Penna., 59, 1893.

The Golden Shad, or Skipjack, is a common inhabitant of the Ohio and Mississippi valleys and the Gulf of Mexico. In Pennsylvania this fish is confined to the Ohio and its tributaries. It prefers large streams. It has made its way into the Great Lakes through canals. The presence of the Golden Shad in the salt water of the Gulf of Mexico was discovered by Silas Stearns near Pensacola, Fla. This species grows to a length of 18 inches.

Unlike most other species of *Clupea*, this one, according to observations of Prof.

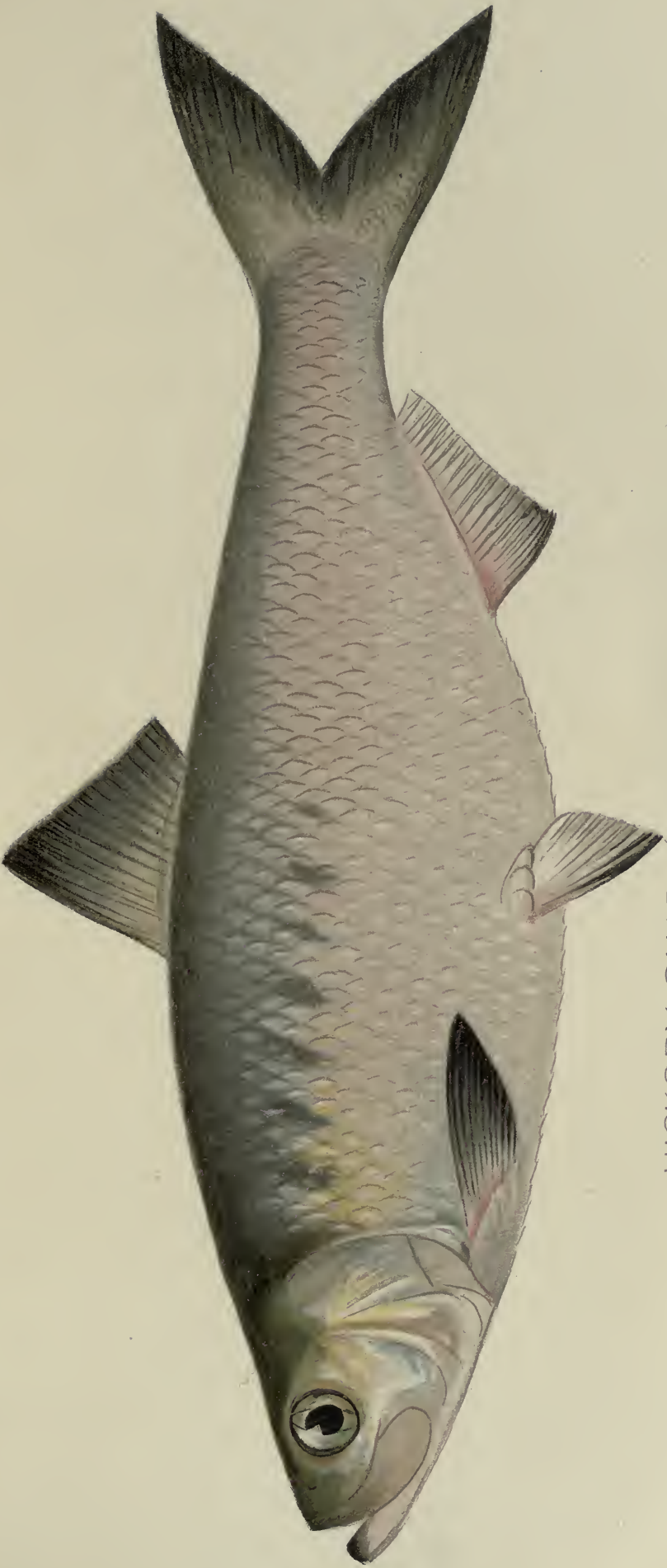


SKIPJACK.

S. A. Forbes of Illinois, is predaceous, feeding on other fishes. Two examples examined by him had eaten gizzard shad, *Dorosoma*, and another one individuals of some unidentified fish. The young of the Golden Shad, $2\frac{1}{4}$ inches long, had consumed nothing but terrestrial insects, including flies, small spiders, etc.

Apparently it never ascends small streams. In the lower part of the Mississippi valley it migrates into salt water. In the upper part of this valley it is a permanent resident in fresh water. The name Skipjack is given in allusion to its habit of skipping along the surface of the water when in pursuit of its prey. In the water its movements are graceful and active.

The fish is full of small bones and its flesh is reputed to be tasteless and without value as food; but Kirtland says it is esteemed in Ohio as a good pan fish.



HICKORY SHAD [*POMOLOBUS MEDIOCRIS*].

43. Hickory Shad (*Pomolobus mediocris* Mitchill).

Clupea mediocris JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 266, 1883; BEAN, 19th Rept. N. Y. Comm. Fish., separate, 43, pl. XXV, fig. 34, 1890.

Alosa mattowaca DEKAY, N. Y. Fauna, Fishes, 260, pl. 40, fig. 127, 1842.

This species is referred to by Dr. Mitchill as the Staten Island Herring, *Clupea mediocris*, which, he says, grows very large for a herring, being frequently 18 inches long and almost as big as a small shad. It has "six or eight brown spots, longitudinally, below the lateral line," as reported by an inhabitant of that part of the bay of New York which borders on Staten Island. Mitchill also has the same species under the name of Long Island Herring, *Clupea mattowaca*. This, he says, is also called the Autumnal or Fall Herring, as well as Shad Herring and Fall Shad. Mitchill recognized it as probably the full grown fish of the *C. mediocris*. He was not able to distinguish it from that species. The length of the



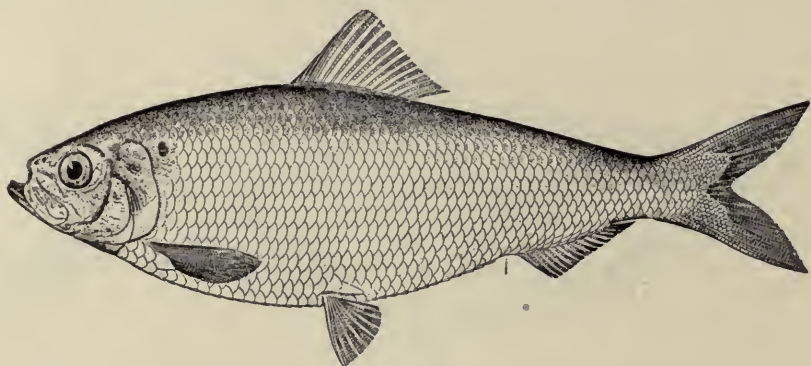
HICKORY SHAD.

Green Back, according to this writer, frequently reaches 2 feet, with a depth of from $4\frac{1}{2}$ to 6 inches. At the time of this writing the fish was taken in October and November in seines on the surf side of the beaches fronting Long Island. Dr. DeKay mentions examples in the market early in July, which are brought from the Connecticut River, where they are called Weesick. He states that the specific name bestowed on it by Mitchill was derived from the aboriginal name of the island, Mattowaca or Mattowax. In Great South Bay the name Green Back is well established for the species. A single example was seined, September 29, at Fire Island. October 1, 1890, considerable numbers of large Green Backs were caught in a trap at Islip. The Hickory Shad is caught in Gravesend Bay during September, October and November, but is less plentiful than it was formerly. Large Hickory Shad weighing from $\frac{1}{2}$ pound to $2\frac{1}{2}$ pounds were shipped from waters near New York City to Fulton Market October 30, 1896. Each of them had in its stomach from

15 to 20 Sand Lance from $3\frac{1}{2}$ to 5 inches long. A few specimens were seined at Blue Point Cove, Great South Bay, and at Howell's Point, in the same bay, August 31, 1898.

At Woods Hole, Mass., it comes in the spring, but is most numerous late in September and till trap fishing ends. In October, 1895, a trap near Tarpaulin Cove caught 3,500 at one lift. These brought 10 cents each in New York. In spring and summer the fish has no market value, but it sells in the fall.

The name Hickory Shad is applied to this species from the Chesapeake Bay region southward, and in some Georgia rivers this is abbreviated to Hicks. In the Potomac and some other rivers tributary to the Chesapeake, the name Tailor Shad is applied to this fish. The Hickory Shad occurs from Maine to Florida, entering rivers except in New England. The species is much less valuable than the shad, for which it is often sold by dealers. Nothing definite is known about its habits, but



BRANCH HERRING.

Marshall McDonald was of the opinion that it spawns in the rivers at a little earlier period than the shad, which it always precedes in the ascent of the streams in spring.

44. Branch Herring (*Pomolobus pseudoharengus* Wilson).

Clupea vernalis JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 267, 1883; BEAN, Fish & Fish. Ind. U. S., I, 588; Fishes Penna., 58, pl. 25, fig. 45, 1893.

Alosa tyrannus DEKAY, N. Y. Fauna, Fishes, 258, pl. 13, fig. 38, 1842.

The Branch Herring, River Herring, or Alewife has a variety of additional names. It is the Ellwife or Ellwhop of Connecticut River, the Spring Herring of New York, the Big-eyed and Wall-eyed Herring of Albemarle, the Sawbelly of Maine, the Grayback of Massachusetts, the Gaspereau of Canada, Little Shad of certain localities, and the Cayuga Lake Shad of New York. The recorded range of the Branch Herring is from the Neuse River, N. C., to the Miramichi River, in New Brunswick, ascending

streams to their headwaters for the purpose of spawning. The fish is found abundant in Cayuga and Seneca Lakes, N. Y., where it has probably made its way naturally. In Lake Ontario, since the introduction there of the shad, the Alewife has become so plentiful as to cause great difficulty to fishermen, and its periodical mortality is a serious menace to the health of the people living in the vicinity. The belief is that the fish were unintentionally introduced with the shad. In Pennsylvania the Branch Alewife occurs in the Delaware and the Susquehanna in great numbers in early spring.

The U. S. Fish Commission, in 1894, obtained specimens at the following localities of the Lake Ontario region: Cape Vincent, June 21; Grenadier Island, June 27; mouth Salem River, Selkirk, July 25; Long Pond, Charlotte, N. Y., August 17; Lake Shore, mouth Long Pond, August 17; Sandy Creek, North Hamlin, August 20.

Not a native of Cayuga Lake, but often found there in large numbers. Known to the fishermen as Sawbelly. It is thought to have been introduced into the lakes of Central New York by the State Fish Commission. Large numbers are often found dead on the shores of Seneca and Cayuga Lakes. (After Meek.) DeKay says it appears in New York waters with the shad about the first of April, but never in sufficient numbers to form a separate fishery.

The Branch Herring, or Alewife, is the first of the alewives to appear in Gravesend Bay; it comes with the shad. It endures captivity well. November 30, 1897, individuals above 7 inches in length were caught in Gravesend Bay, which were probably the young of the year.

The Alewife seldom exceeds 1 foot in length, the average market examples being about 10 inches. The weight of the largest is about $\frac{1}{2}$ pound, and the average weight is about 5 or 6 ounces.

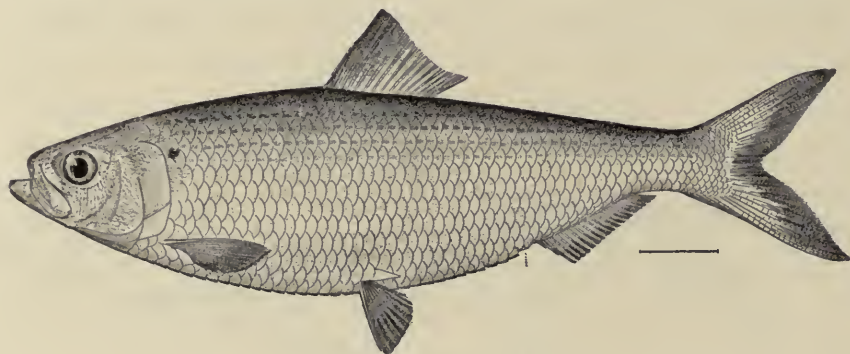
The fish enter the rivers earlier than the shad and return to the sea, or to estuaries adjacent to the river mouths at some undetermined date in the fall. During the summer months enormous schools of full-grown, but sexually immature alewives migrate along the coast, feeding on small crustaceans and themselves furnishing food for bluefish, sharks, porpoises and other predaceous animals; but none of them are known to enter fresh water. In the rivers the alewives appear to eat nothing, but they can be captured with small artificial flies of various colors. Their eggs are somewhat adhesive and number from 60,000 to 100,000 to the individual. They are deposited in shoal water; spawning begins when the river water is at 55° to 60° F. The period of hatching is not definitely known, but is believed to exceed four days.

During the spring and summer the young grow to a length of 2 and 3 inches;

after their departure from the streams nothing is known of their progress, but it is believed that they reach maturity in four years. We have no means of learning the age of the immature fish seen in great schools off shore, and thus far the rate of growth is unsettled.

The Branch Alewife, though full of small bones, is a very valuable food fish and is consumed in the fresh condition as well as dry salted, pickled and smoked. The fry can be reared in ponds by placing adults in the waters to be stocked a little before their spawning season; and they furnish excellent food for bass, rockfish, trout, salmon and other choice fishes. The proper utilization of the immense oversupply of these fish in Lake Ontario has become a serious economic problem.

Alewives are caught in seines, gillnets, traps and pounds, and they are often taken by anglers with artificial flies.



GLUT HERRING—MALE.

45. Glut Herring (*Pomolobus cyanonoton* Storer).

Pomolobus æstivalis GOODE & BEAN, Bull. Essex Inst., 24, 1879; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 246, 1896.

Clupea æstivalis JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 267, 1883.

Mitchill's name, *æstivalis*, cannot be applied with any certainty to the "Glut Herring;" it appears to be a synonym of *mediocris* and *mattowaca* of the same author. Its relation to *mattowaca* was long since pointed out by Dr. Gill. The description herewith appended appears to make this conclusion inevitable. (Mitchill, Trans. Lit. & Phil. Soc. N. Y. p. 456, pl. 5, fig. 6, 1814.)

Summer Herring of New York. (*Clupea æstivalis*.) Has a row of spots to the number of seven or eight, extending in the direction of the lateral line. Tail forked. Belly serrate; and, in most respects, resembling the *C. halec*, herein already described. Rays: Br. 6; P. 15; V. 9; D. 16; A. 19; C. 19.

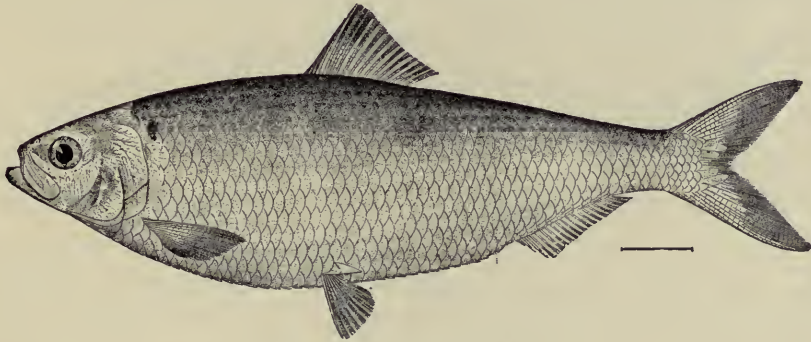
The figure shows a row of eight spots on the side extending as far back as the

end of the dorsal fin on the level of the eye. This resembles the hickory shad, *Pomolobus mediocris*, more than anything else, and it probably was that species.

The Glut Herring arrives later than the Branch Herring and does not ascend streams far above salt water. It appears to spawn only in the larger streams or their tidal tributaries and at a temperature of 70° to 75° ; while the Branch Herring spawns in water as low as 55° to 60° and ascends far up the streams and their small fresh-water branches.

In Gravesend Bay the Glut Herring is called Shad Herring. November 30, 1897, two young fish of the year, measuring about 7 inches in length, were obtained from that bay. In Great South Bay the species is called Herring. A single example was secured there on September 29, 1890. In 1898 it was not collected either in Great South Bay or Mecox, in both of which the Branch Herring was abundant.

At Provincetown the species is known as the Blueback and Kiouk. According to



GLUT HERRING—FEMALE.

Storer, it appears there in small numbers in May, but is not abundant before June 10, and it remains on the coast for a short time only. The Alewife, or Branch Herring, arrives on the coast of Massachusetts about the end of March, and is taken till the middle or last of May.

46. Shad (*Alosa sapidissima* Wilson).

Clupea sapidissima BEAN, Fishes Penna., 60, pl. 2, 1893; CHENEY, 4th Ann. Rep. N. Y.

Com. Fish, colored pl. facing p. 8, 1899.

Alosa praestabilis DEKAY, N. Y. Fauna, Fishes, 255, pl. 15, fig. 41, 1842.

Alosa sapidissima JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 427, 1896, pl.

LXXII, fig. 191, 1900.

The Shad is known also as the White Shad, and in the Colonial days it was known to the negroes on the lower Potomac River as Whitefish. It is found naturally along the Atlantic Coast of North America from the Gulf of St. Lawrence to

the Gulf of Mexico, ascending streams at various dates from January in its extreme southern limit to June in far northern waters. In the Delaware and Susquehanna it makes its appearance in April and departs after spawning; but remains, sometimes, as late as July 18, and many die.

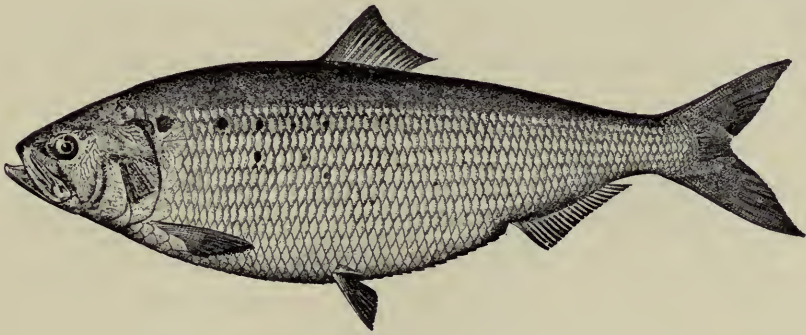
The original distribution of the shad has been widely extended by artificial introduction. In certain rivers flowing into the Gulf of Mexico the fish has been established by planting. In the Ohio River a fishery has been created by the same method; and in the Sacramento River, Cal., the shad was successfully introduced, and it has colonized not only this river but all suitable rivers from San Francisco to Southern Alaska. It is now one of the common market species in San Francisco and other west coast cities.

In the Susquehanna the shad was formerly one of the most important native food fishes, but its range is now very limited on account of obstruction by dams. Twenty years ago the Fish Commission reported that a few shad are taken yearly above the Clark's Ferry dam, none, or at least a few dozen, above the Shamokin dam, none above the Nanticoke dam and none above Williamsport. The largest run of shad that has been known to pass the Columbia dam was that of 1867. "In 1871 the finest Columbia shad were hawked in the market at Harrisburg, 30 miles from the fisheries, at considerable less than a dollar a pair. The catch at Columbia exceeded 100,000."

The obstructions in the Delaware have been almost entirely overcome. In 1891 shad were caught higher up the Delaware than for many years, and spawned in the upper reaches of the river beyond the New York State line. In 1891 the Delaware, for the first time since 1823, was restored to its normal condition by means of the fishway at Lackawaxen; and, according to Col. Gay, it is at present the best shad river in the country. The number of eggs obtained for artificial propagation in the lower river was unusually small, but the number naturally deposited in the upper waters was greater than for many years. Col. Gay observed a large number of big female shad at Gloucester City, but a great scarcity of males. This necessitated a long run up the river before spawning. The cause is believed to be the lower temperature of the water during May, the lack of rain cutting off the usual supply of warm surface water and the tributaries of the upper river bringing down nothing but cold spring water, keeping the temperature of the river below the normal for spawning purposes. Consequently the shad ascended more than 300 miles. Mr. Ford noticed that every pool in the upper river was full of shad, and he saw them playing in the water by hundreds. Mr. Van Gordon saw them above Port Jervis, and they were observed as far up as Deposit, N. Y.

The shad reaches a length of 2 feet. It is asserted that 50 years ago shad weighing from 8 to 13 pounds were not uncommon in the Susquehanna. It is said that even larger individuals were taken. In California the shad reaches a larger size than it does in the east, specimens weighing from 13 to 14 pounds being often seen in the markets. The average weight of the females is 4 or 5 pounds. The male is much smaller.

The young shad remain in the rivers till the approach of cold weather, when they descend to the sea, and they are usually seen no more till they return as mature fish ready for reproduction. They are known to feed on small flies, crustaceans and insect larvæ. They have been fed with fresh-water copepods and kept alive in this way till they obtained a length of more than 1 inch. In the Carp ponds at Washington, Dr. Hessel succeeded in rearing shad on the *Daphnia* and *Cyclops* to



SHAD.

a length of 3 or 4 inches, and one time, when they had access surreptitiously to an abundant supply of young carp, well-fed individuals reached a length of 6 inches by the first of November. Shad have been kept at the central station of the U. S. Fish Commission over the winter, but at the age of one year, doubtless for lack of sufficient food, the largest was less than 4 inches long. At this age they were seen to capture smaller shad of the season of 1891, which were an inch or more in length. The Commissioner of Fisheries detected young shad also in the act of eating young California salmon; and on one occasion found an undigested minnow, 2 or 3 inches long, in the stomach of a large shad, and they have been caught with minnows for bait. The principal growth of the shad takes place at sea, and when the species enters the fresh waters for the purpose of spawning it ceases to feed, but will sometimes take the artificial fly and live minnows. The migratory habit of the shad has already been referred to. The spawning habits have been thus described by Marshall McDonald:

The favorite spawning grounds are on sandy flats bordering streams and on sand

bars. The fish appear to associate in pairs, usually between sundown and 11 P. M. When in the act of spawning they swim close together near the surface, their dorsal fins projecting above the water and their movements producing a sound which the fishermen call "washing." The eggs are expressed by the female while in rapid motion; the male following close and ejecting his milt at the same time. Such of the eggs as come in contact with the milt are impregnated, but the greater portion of them are carried away by the current or destroyed by spawn-eating fishes. After impregnation the egg sinks to the bottom and under favorable conditions develops in from three to eight days. According to Seth Green, the embryo shad swim as soon as they break the shell and make their way to the middle of the stream where they are comparatively safe from predaceous fishes. A mature female shad of 4 or 5 pounds contains about 25,000 eggs on the average, but as many as 60,000 have been obtained from a 6-pound fish, and 100,000 were obtained from a single female in the Potomac. There is great mortality among the shad after spawning. Dead fish of both sexes are frequently seen floating in the water in the late months of summer.

Mitchill states that the shad visits New York annually about the end of March or beginning of April; that it ascends toward the sources of the Hudson; that it usually weighs 4 or 5 pounds, but sometimes as much as 12 pounds. DeKay says a large variety, supposed to be old fish, and weighing from 10 to 12 pounds, were frequently taken in the Hudson, under the name of Yellow Backs. The shad, in his time, ascended the river 150 miles to spawn, and descended in the latter part of May. The introduction of gill nets, he writes, has caused a scarcity of the fish and will drive them from the river before many years.

Nets set off shore in Gravesend Bay in the fall frequently enclose large quantities of young shad, sometimes a ton and a half at one time, during their migration seaward, but they are at once liberated. The fish are usually about 6 to 8 inches long. October 17, 1895, sixty or seventy were caught in John B. DeNyse's pound, among them a male 11 inches long and $2\frac{3}{4}$ inches deep, and a female 12 inches long and 3 inches deep. October 31, 1895, a male $13\frac{1}{2}$ inches long and $2\frac{1}{2}$ inches deep, and a female $13\frac{1}{2}$ inches long and $3\frac{1}{2}$ inches deep were obtained in the same pound. Apparently the shad do not all remain at sea after their first migration till they are sexually mature. In the Potomac River young shad 8 to 9 inches long occasionally enter in the spring with the adults in large numbers. Mr. DeNyse informs me that in the first spring run of small shad in Gravesend Bay fully 90% are males.

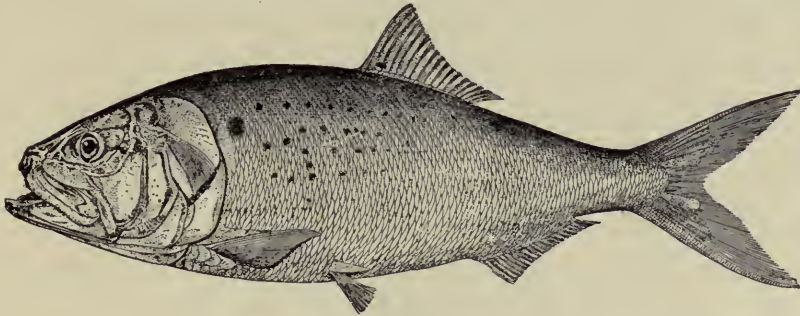
47. Menhaden (*Brevoortia tyrannus* Latrobe).

Clupea menhaden MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 453, pl. V, fig. 7, 1815, New York.

Alosa menhaden DEKAY, N. Y. Fauna, Fishes, 259, pl. 21, fig. 60, 1842.

Brevoortia tyrannus BEAN, 19th Rept. N. Y. Comm. Fish, separate, 44, pl. XXV, fig. 35, 1890; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 433, 1896, pl. LXXIII, fig. 195, 1900.

The Menhaden has received more than 30 common names, among which the one here employed is the best known and most suitable. In New Jersey it is frequently called Bunker or Moss Bunker, and in some other localities it is the Bony Fish. It is also called Bugfish, because of a crustacean parasite which is found in the mouth.



MENHADEN.

The Menhaden reaches a length of 15 inches or more; its average size is about 1 foot. It is found along our east coast from Maine to Florida, swimming in immense schools and fluctuating greatly in abundance. In certain localities its movements are affected chiefly by temperature.

The use of the Menhaden as a source of oil and a material for fertilizers is so well known as scarcely to need mention here. As an edible fish it is not generally esteemed; in most localities it is seldom eaten, though in some places it is considered a good food fish. Since the mackerel is becoming scarce, Menhaden are often salted in barrels as a substitute for that fish.

The Menhaden appears in Dr. Mitchill's Fishes of New York as the Bony Fish, Hardhead or Marshbanker. The aboriginal name Menhaden, and the one most suitable for the species, is mentioned by this writer. Dr. DeKay, in his New York Fauna, introduced the name Mossbunker as well as the Indian names Panhagen and Menhaden. He notes also the names Skippang and Bunker as in use at the east end of the island. For a survey of the 30 or more additional appellations of this

well-known fish, the reader is referred to the complete history of the American Menhaden by Dr. G. Brown Goode.

The Menhaden comes into Gravesend Bay in May and through the summer. Occasional individuals are seen there in the fall as late as November. The fish can be kept alive in winter in captivity, provided the water temperature does not fall below 50° F. It makes its appearance on the shores of Long Island about the beginning of June, sometimes in May, and remains till the cold season sets in. A few specimens were taken September 22 in Blue Point Cove in 1884, and October 1, 1890, many thousands were caught in a trap at Islip; these were large and very fat fish. The use of the Menhaden as a bait fish is too well known to need special mention. In "chumming" for Bluefish near Fire Island Inlet this is the favorite bait. In 1898 the young were obtained at Duncan's Creek, Howell's Point and Nichols's Point August 29. Adults were sent from Islip by W. F. Clock August 18.

In the vicinity of Woods Hole, Mass., according to Dr. Smith, Menhaden arrive in schools about May 20, but scattered fish are taken in March with Alewives; they remain till December 1, sometimes till December 20, but are most abundant in June. When the schools first arrive, the reproductive organs of many of the fish are in an advanced stage of development, but after July 1, none with large ovaries are found. Late in fall the fish again have well-developed roes. The smaller fish are about an inch long; these are found in little schools about the shores and wharves as early as July 15. The young are abundant throughout summer and fall. The average length of adults is 13 or 14 inches; one fish 18 inches long was caught at Woods Hole in 1876.

48. Striped Anchovy (*Stolephorus brownii* Gmelin).

Clupea vittata MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 456, 1815; DEKAY N. Y. Fauna, Fishes, 254, 1842.

Stolephorus brownii JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 273, 1883; BEAN, Bull. U. S. F. C., VII, 149, 1888; Rept. N. Y. Comm. Fish., 279, 1890.

The species occurs from Cape Cod southward to Brazil and the West Indies.

This is the Satin Striped Herring of Mitchill's Fishes of New York, p. 456. By some of the fishermen in Great South Bay it is supposed to be the Whitebait, and is so called. The Anchovy was extremely abundant in the bay in September, 1884. I found it at the mouth of Swan Creek, in Blue Point Cove, near the Life Saving Station, at Oak Island and at Fire Island. Specimens were seen as late as October 7.

This Anchovy forms a very important part of the food of the young weakfish and bluefish in Great South Bay. It is present in very large numbers and could be

utilized as a food species. The largest examples of this fish which we have seen were taken in Great Egg Harbor Bay in August; individuals measuring $5\frac{1}{2}$ inches in length were taken in the surf by hundreds, and weakfish were feeding on them ravenously. In two hauls of a 20-fathom seine we took here 54 weakfish.

This species was not common in Great South Bay during the summer of 1898. It was found at Blue Point Cove August 18, and young were obtained at Nichols's Point September 1.

Dr. Smith records it as unusually abundant at Woods Hole, occasionally rather uncommon. Found from August to late in fall. More numerous than any other Anchovy.

49. Anchovy (*Stolephorus mitchilli* Cuv. & Val.).

Stolephorus mitchilli JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 248; BEAN, Bull. U. S. F. C., VII., 149, 1888; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 446, 1896.

Cape Cod to Texas on sandy shores; the most abundant of the New York species. It enters Gravesend Bay in May and remains till October. Locally known as Anchovy and Whitebait. An excellent food fish and very important as the food of larger fishes.

It is very generally distributed in bays along the south shore of Long Island, having been found abundant in Scallop Pond, Peconic Bay, in Mecox Bay, and almost everywhere in Great South Bay from July to September, 1898. A specimen taken at Fire Island has a lernæan parasite attached to it. At Woods Hole, Mass., Dr. Smith reports it abundant, associated with *S. brownii*.

50. Round Whitefish (*Coregonus quadrilateralis* Richardson).

Coregonus quadrilateralis JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 298, 1883; BEAN, Fishes Penna., 66, pl. 26, fig. 47, 1893.

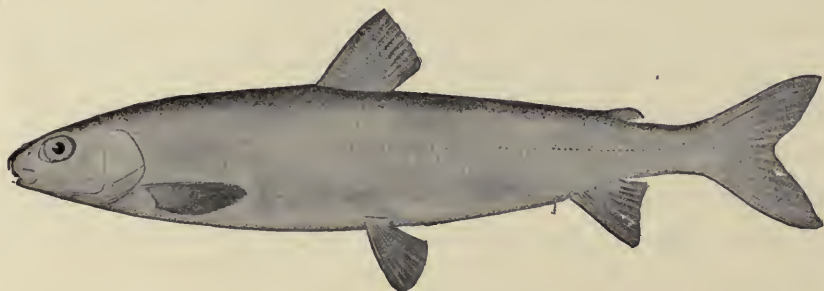
This species is called Frost Fish in the Adirondacks; other names are Menominee Whitefish, Roundfish, Shad-waiter, Pilot-fish and Chivey, the last term applied to the fish in Maine.

The Round Whitefish is found in lakes of New England, sometimes running into streams, the Adirondack region of New York, the Great Lakes and northward into British America and Alaska. Its distribution has been extended by transplanting on account of its great value as food for the Lake Trout and other large fish of the Salmon family. It seldom exceeds a length of 12 inches and a weight of 1 pound. Like some other species of Whitefish it spawns in shallow parts of lakes or ascends

their small tributaries for that purpose. The food consists of small shells and crustaceans. The species frequents deep waters, where it falls an easy prey to the voracious Lake Trout.

The Round Whitefish is excellent for the table. Its capture with hook and line is difficult because of its very small mouth and its habit of retiring into deep water. In the Great Lakes it does not constitute an important element of the fishery, but in northern regions it is one of the most useful and highly prized of the food fishes.

This small Whitefish is one of the characteristic species of the Adirondack Lakes. James Annin, Jr., sent specimens for identification from Hoel Pond and Big Clear Lake, in Franklin County, N. Y., and from the third lake of the Fulton



ROUND WHITEFISH.

Chain. He states that the fish spawns in the little inlets or on the sand beaches. It never appears until about the time the water begins to chill and freeze about the edges. On the Fulton Chain of lakes the spawning season of 1895 was practically closed about November 20. The Frostfish, according to Mr. Annin, is "a delicious morsel."

An example taken at Sanarac Lake, November 23, 1897, showed the following colors: Purplish gray; lower parts whitish; pectorals, ventrals and anal vermilion; eye pale golden; head especially behind the eyes with iridescent gold and purple tints; caudal, chiefly vermilion in life. The fish is a male with ripe milt. There are numerous small tubercles on the scales of the sides above and below the lateral line.

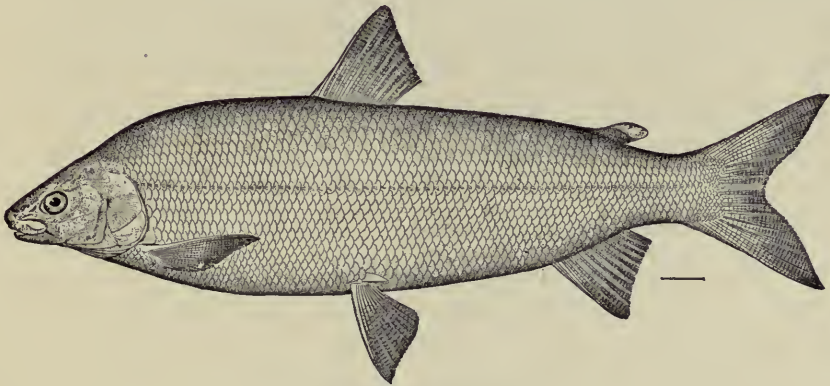
51. Common Whitefish (*Coregonus clupeiformis* Mitchill).

Coregonus albus KIRTLAND, Bost. Jour. Nat. Hist., III, 477, pl. XXVIII, fig. 3, 1841;
DEKAY, N. Y. Fauna, Fishes, 247, pl. 76, fig. 240, 1842.

Coregonus clupeiformis JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 299, 1883; BEAN,
Fishes Penna., 67, color pl. 3, 1893; JORDAN & EVERMANN, Bull. 47, U. S. Nat.
Mus., I, 465, 1896, pl. LXXVI, fig. 202, 1900.

The name Whitefish is thoroughly identified with this species and is seldom varied except by means of the prefix "common" or "lake." A well-marked variety in Otsego Lake, N. Y., has long been known as the Otsego Bass.

The Common Whitefish occurs in the Great Lakes and northward into British America; its northern limit is not definitely known. In Alaska, where the species was formerly supposed to exist, it is replaced by a similar, but well-marked form,



COMMON WHITEFISH.

the *Coregonus richardsoni* of Günther. The variety known as Otsego Bass is found in Otsego Lake. If we may judge from the yield of the fisheries, Lake Michigan has more Whitefish than any of the other lakes; Superior ranks second; Erie third; Huron fourth; and Ontario is sadly in the rear.

The largest individual on record was taken at Whitefish Point, Lake Superior; it weighed 23 pounds. A 17-pound specimen was caught at Vermilion, in Lake Erie, in 1876. The size varies greatly with locality, ranging in general all the way from $1\frac{3}{4}$ pounds to 14 pounds. In Lake Erie, in 1885, the average weight was between 2 and 3 pounds. The length of adults will average 20 inches.

There is a movement of the Whitefish in many lakes from the deep water early in the summer into the shoal water near the shore. In the mid-summer, however, the usual retreat of this species is the deep and cold parts of the lakes which they inhabit. Again as the spawning season approaches, in October, the Whitefish come toward the shore to deposit their eggs. It is said that they do not spawn till the

water has reached a temperature of about 40°. After spawning they again retire to deep water where they remain during the winter. Mr. Milner observed that the shoreward migration varies with locality and is influenced also by depth of water and temperature. In Lake Erie, for example, which has a high summer temperature, there is no shoreward migration in summer. It is noted also that the Whitefish moves along the shore and in some cases it ascends rivers for the purpose of spawning. It is believed also that when the feeding grounds of the Whitefish are polluted by mud the fish temporarily seek other localities. There appears to be a spring and summer migration likewise from lake to lake. Spawning takes place during October, November and December on shoals or occasionally in rivers. The female is larger than the male. According to the observations of George Clarke, the two sexes in the act of spawning frequently throw themselves together above the surface, emitting the spawn or milt with the vents close together. Spawning operations are most active in the evening, are continued at night and the eggs are deposited in lots of several hundred at a time. The number of eggs in a fish of 7½ pounds was 66,606; the average number being nearly 10,000 for each pound of the female's weight. The period of incubation depends on the temperature. The usual time of distribution of the young is in March and April. The very young are described as swimming near the surface and not in schools. They are very active and soon seek deep water to escape from their enemies. Their food consists chiefly of small crustaceans. The adults subsist on the same food with the addition of small mollusks.

The only means of determining the rate of growth of the Whitefish is by artificial rearing. Samuel Wilmot had young fish which were 5 inches long at the age of four months. The growth under natural conditions must be even greater than this. Mr. Wilmot has seen Whitefish measuring 7 inches in December in his ponds.

The eggs of the Whitefish are destroyed in immense numbers by the Lake Herring, *Argyrosomus artedi*. The water lizard, *Menobanchus*, also consumes vast numbers of the eggs. The young Whitefish are eaten extensively by the Pikeperch, Black Bass, Pike, Pickerel and fresh-water Ling. The Lake Trout also feed on the Whitefish. A leech parasitic of the Whitefish proves very troublesome to that species, and the scales are liable to a peculiar roughness which has been observed late in November or during the spawning season. There is also a lernean which fastens itself to the gills and other parts of the Whitefish.

The excellence of the flesh of the Whitefish is so well known as scarcely to require mention. Its commercial value is great. In Lake Erie in 1885, according to statistics collected by the U. S. Fish Commission, 3,500,000 pounds of Whitefish

were caught, more than 2,000,000 of this amount by fishermen from Erie alone. In that year Erie County had 310 persons employed in the fisheries. The capital invested in the business was nearly \$250,000. The wholesale value of the fish products was upward of \$400,000. The Whitefish was the third species in relative importance, Blue Pike ranking first, and the Lake Herring second. In Erie County Whitefish are caught chiefly in July, August and November, and the bulk of them are taken in gill nets. Pound nets are also employed in the capture of Whitefish.

Carl Miller of New York and Henry Brown of New Haven are credited with the first attempt to propagate the Whitefish artificially. Their experiments were made in Lake Saltonstall, near the city of New Haven. The result of the experiments, which were repeated in 1858, is not known. In 1868, Seth Green and Samuel Wilmot began a series of experiments in the same direction, and in 1869, N. W. Clark of Clarkson, Mich., took up the same work. In 1870 a half million eggs were placed in hatching boxes by Mr. Clark. In 1872, through the aid of the U. S. Fish Commission, Mr. Clark's hatching house was doubled in capacity, and a million eggs were taken from Lake Michigan. Since that time both the National and State Governments have made the Whitefish the object of their most extensive operations.

Dr. Meek saw no specimens of Whitefish from Cayuga Lake, but he thinks it is an inhabitant. The U. S. Fish Commission obtained a specimen at Cape Vincent, N. Y., November 17, 1891.

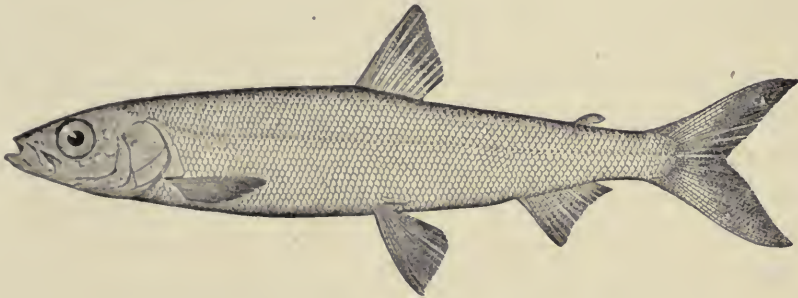
A young individual was received from Wilson, Niagara County, N. Y., caught in a gill net in Lake Ontario and sent by James Annin, Jr.

A male and female were received through James Annin, Jr., from Upper Saranac Lake, November 16, 1895. Both fish were nearly spent. A male from Chazy Lake arrived through the same source November 22, 1895. It was doubtfully called "Blackfin Whitefish." At that time the fish had left the spawning beds and were in deep water. June 17, 1896, a female $19\frac{5}{8}$ inches long was shipped by Mr. Annin from Canandaigua Lake. Its stomach is pear-shaped with walls more than $\frac{1}{4}$ inch thick; it contained numerous small shells of several genera, not yet identified.

The species is reported by fishermen to be very abundant in that lake, and to be destructive to eggs of other fish. They say it comes in great numbers into shallow water near the shore in early summer when the water is roily, and can be caught on set lines. Mr. Annin saw men baiting their set lines with small minnows on Canandaigua Lake, and, when the lines were taken up in the morning, the Whitefish was found on the hooks. It is said that one so taken weighed 6 pounds. Supt. O. H. Daniels, of the New Hampshire Fish Commission, forwarded a specimen from Lake Winnesquam, at Laconia, $19\frac{7}{8}$ inches long, weighing 46 ounces, and he wrote that

individuals weighing $7\frac{1}{2}$ pounds had recently been taken. The species was called "Bluefin" and Whitefish.

The fish-eating habit of the Whitefish was fully verified in the aquarium on examples obtained in Canandaigua Lake in November, 1896, by Mr. Annin. Knowing that the species usually subsists on small mollusks and crustaceans, efforts were made to provide the fish with *Physa* and *Gammarus*; but this became difficult in winter, and an experiment was made with small Killifish (*Fundulus heteroclitus* and *majalis*), which proved satisfactory during the cold months. In summer, however, it was found necessary to return to the use of *Gammarus*. The Whitefish at first took the Killifish without any eagerness, but they soon learned to chase their prey and take it much as trout do.



SMELT.

52. Smelt of New York Lakes (*Argyrosomus osmeriformis* H. M. Smith).

Coregonus osmeriformis SMITH, Bull. U. S. F. C., XIV, 2, pl. 1, fig. 2, 1895, Lakes Seneca and Skaneateles, New York.

Coregonus hoyi BEAN, Proc. U. S. Nat. Mus., V, 658, 1883; GOODE, Fish and Fish. Ind. U. S., I, pl. 197 B, 1884; not *Coregonus hoyi* Gill.

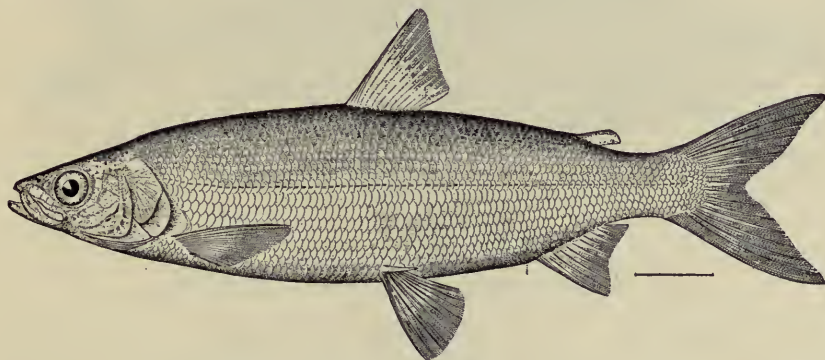
Argyrosomus osmeriformis JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 468, 1896.

Body elongate, moderately compressed, slender; head less compressed than body, its greatest width equaling one-half of distance from tip of lower jaw to nape; the lower jaw projecting considerably even when the mouth is closed; mouth large, the maxillary reaching to the vertical through the anterior margin of the pupil; preorbital bone long and slender, more than one-third as long as the head; supra-orbital as long as the eye, four times as long as broad.

The greatest height of the body is considerably less than the length of head, and is contained five times in the total length without caudal. The greatest width of the body is less than one-half its greatest height. The least height of caudal peduncle equals the length of the orbit and about one-third of the greatest height of the body. Scales small, nine in an oblique series from the dorsal origin to the

lateral line, 82 tube-bearing scales and eight in an oblique series from the ventral origin to the lateral line.

The length of the head is one-fourth of the total length to the end of the lateral line. The distance of the nape from the tip of the snout is nearly one-third of the distance from the tip of the snout to the origin of the first dorsal. The length of the maxilla is one-third of the length of the head. The mandible is one-half as long as the head. Lingual teeth present. The eye is as long as the snout and one-fourth as long as the head. Gill-rakers long and slender, the longest five-sixths as long as the eye; there are 55 on the first arch, 35 of which are below the angle. The insertion of the dorsal is nearer the tip of the snout than the end of the middle caudal rays. The longest ray of the dorsal equals the length of the ventral and is contained seven times in the total length to the end of the middle caudal rays (six and two-thirds times in length to end of lateral line). The length of the pectoral is one-sixth of the standard body length.



LAKE HERRING.

The insertion of the ventral is midway between the tip of the snout and the end of the middle caudal rays. When the ventral is extended the distance of its tip to the vent is only one-fourth of the length of the fin. In this respect the species differs widely from *A. artedii*.

The colors are, back grayish silvery; sides silvery; dorsal and caudal with darker tips.

53. Lake Herring (*Argyrosomus artedii* LeSueur).

Coregonus artedii JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 301, 1883; BEAN, Fishes Penna., 69, pl. 26, fig. 48, 1893.

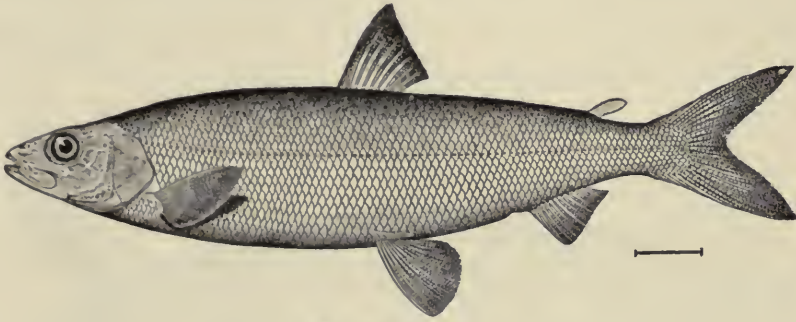
Corogonus clupeiformis DEKAY, N. Y. Fauna, Fishes, 248, pl. 60, fig. 198, 1842.

Argyrosomus artedii JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 468, 1896.

The Lake Herring frequents shoal waters and occurs in enormous schools, as one may judge from the quantity captured in Lake Erie. Its food consists of

insects and crustaceans. During the spawning season of the Whitefish, however, it feeds exclusively on the eggs of this species and proves very destructive. The Lake Herring will take the hook, and has been caught with live minnows. Spawning takes place about the end of November in shoal waters.

As a food fish this species is inferior to the Whitefish, but it is in great demand over an extensive area of the country, and is shipped in the fresh condition many hundred miles east and west. I have elsewhere referred to the enormous number taken in 1885 in Lake Erie. These are caught chiefly in pound and gill nets. The catch in 1885 amounted to more than one-third of the entire quantity of fishes taken in this lake. There is no apparent diminution in the number of these fishes, and their artificial propagation has only recently been commenced.



MOONEYE CISCO.

Mooneye Cisco (*Argyrosomus hoyi* Gill).

Argyrosomus hoyi GILL, Mss.; JORDAN, Amer. Naturalist, 135, March, 1875, Lake Michigan, near Racine, Wis.; BEAN, Bull. Amer. Mus. Nat. Hist., IX, 342, 1897, Canandaigua Lake; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 464, 1896. *Coregonus hoyi* JORDAN, Man. Vert. ed. 2, 275, 1878; JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 299, 1883; SMITH, Bull. U. S. F. C., XIV, 6, pl. 1, fig. 1, 1895.

Mr. Annin wrote me that the people at Canandaigua Lake told him that there were large quantities of small Lake Shiners, as they are called, in the lake. A fisherman said that they are seen in immense schools at the top of the water occasionally, and, by firing a gun loaded with shot into them, men can stun them so as to pick up quite a number. They are eagerly sought after for trolling bait for the Salmon Trout found in that lake.

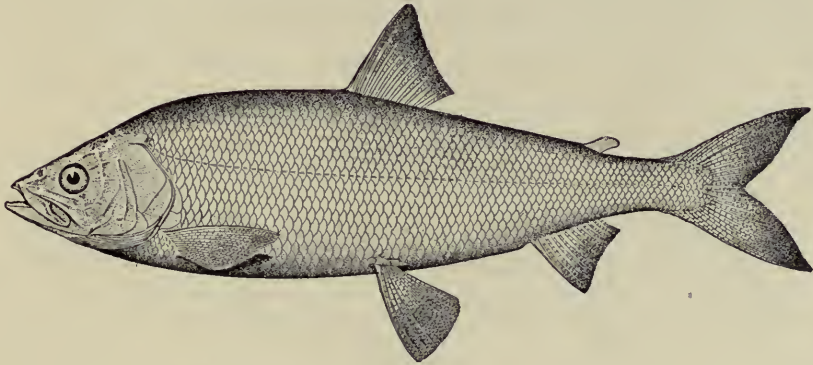
This species is recorded with certainty from Lake Michigan only. It is taken in gill nets in deep water and, notwithstanding its small size, has become commercially important. It was for the first time announced as a member of the New York fauna in 1897, and the description leaves no doubt of the correctness of the identi-

fication. The fish examined, a female with ripe eggs, was taken in Canandaigua Lake, December 19, 1896, by Mr. Annin's men. It was the only one caught, and was captured by becoming gilled in the funnel of the net. Mr. Annin is satisfied that this is the Lake Shiner of the fishermen, which they sometimes see in immense schools at the surface, and kill for trolling bait by shooting them.

55. **Long Jaw; Bloater** (*Argyrosomus prognathus* H. M. Smith).

Coregonus prognathus HUGH M. SMITH, Bull. U. S. F. C., XIV, 4, pl. 1, fig. 3, 1895, Lake Ontario, at Wilson, N. Y.

Argyrosomus prognathus EVERMANN & SMITH, Rept. U. S. F. C., XX, 314, pl. 26, 1896; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 471, 1896.



LONG JAW.



OUTLINE OF FISH, VIEWED FROM ABOVE.

Body oblong, much compressed, back elevated, tapering rather abruptly toward the narrow caudal peduncle, the adult fish having a slight nuchal hump as in *C. clupeiformis*; greatest depth three and one-half to four in body length; head rather short and deep, pointed, four to four and one-third in length; greatest width half the length, cranial ridges prominent; snout straight, its tip on level with lower edge of pupil; top of head two in distance from occiput to front of dorsal; mouth large and strong, maxillary reaching to opposite middle of pupil, two and one-half in head, length three times its width, mandible long, projecting beyond upper jaw when mouth is closed, reaching to or beyond posterior edge of eye, one and three-fourths to one and seven-eighths in head; eye small, five in head, one and

one-half in snout, one and one-third in interorbital space, one and one-half in suborbital space; gill rakers slender, about length of eye, 13 above and 25 below angle. Adipose fin the length of eye, its width half its length. Narrowest part of caudal peduncle contained nearly four times in greatest body depth. Dorsal rather high, with nine or ten developed rays, the longest one-half longer than base of fin and contained one and three-fourths times in greatest body depth, three and one-fourth times in distance between dorsal and snout, and one and one-half times in head; free margin slightly concave; origin midway between end of snout and base of caudal; dorsal base opposite nine scales. Anal with 10 to 12 developed rays, the longest ray equal to base of fin and two-thirds of height of dorsal. Ventrals as long as dorsal is high, their origin midway between anterior edge of orbit and base of caudal. Ventral appendage short, covering about three scales. Pectorals as long as ventrals. Scales rather large, about 75 in lateral line, seven or eight above the lateral line, seven or eight below the lateral line. Lateral line straight except at origin, where it presents a rather marked curve. Sides of body uniformly bright silvery, with pronounced bluish reflection in life; the back dusky, the under parts pure white without silvery color. Above lateral line, light longitudinal stripes involving central part of scales extend whole length of body. Fins flesh color or pinkish in life, the dorsal and caudal usually showing dusky edges; postorbital area with a bright golden reflection; iris golden, pupil black. Branchiostegals, eight. Average length, 15 inches.

Habitat. Lake Ontario, Lake Michigan, Lake Superior, and doubtless the entire Great Lake basin, in deep water. This fish is called Long Jaw in Lakes Michigan and Ontario. Specimens were obtained from John S. Wilson, of Wilson, N. Y., and from George M. Schwartz, of Rochester, N. Y. Dr. R. R. Gurley also secured examples at Nine Mile Point, N. Y., in June, 1893.

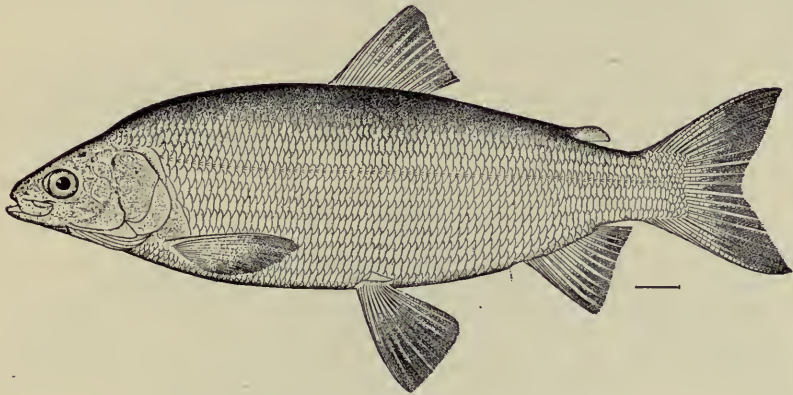
This species is quite different from any other Whitefish inhabiting the Great Lake basin. It may be at once distinguished from all the Whitefishes known to occur in the United States by the general form of body combined with the very long lower jaw, which is contained less than twice in the length of the head and extends backward to or beyond the posterior edge of orbit.

56. **Tullibee; Mongrel Whitefish** (*Argyrosomus tullibee* Richardson).

Coregonus tullibee JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 301, 1883; BEAN, Fishes Penna., 70, pl. 27, fig. 49, 1893.

Argyrosomus tullibee JORDAN, Man. Vert. ed. 2, 361, 1878; EVERMANN & SMITH, Rept. U. S. F. C., XX, 320, pl. 28, 1896; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 473, 1896; BEAN, Bull. Amer. Mus. Nat. Hist., IX, 343, 1897.

The body of the Tullibee is very short, deep and compressed; its greatest height about one-third of the length without caudal. The head is pointed, as in the black-fin, the mouth large, with the lower jaw scarcely longer than the upper. The maxilla extends to below the middle of the eye. The eye equals the snout in length and is two-ninths of length of the head. Scales much larger on front part of



TULLIBEE.

body than on the caudal peduncle. The gill rakers are long, slender and numerous, about 30 below the angle on the first arch. D. 11; A. 11. Scales in lateral line 74, eight rows above and seven below lateral line; pyloric cæca, 120. The upper parts are blueish; sides white and minutely dotted. The spermary, according to Richardson, is wood-brown.

This species is usually called the Tullibee, but in Lakes Erie and Michigan it is sometimes styled the Mongrel Whitefish on the supposition that it is a cross between the common Whitefish and the Lake Herring.

The Tullibee has been taken recently in Lake Michigan; and Dr. E. Sterling had a specimen from Lake Erie. It is found occasionally in others of the Great Lakes, and extends northward into British America, but is comparatively little known to the fishermen and is very rare in collections. This fish grows to a length of 18 inches.

The late F. C. Gilchrist was the first to describe the habits of the Tullibee, and this he did in *Forest and Stream* in the following language:

In September they will again be found gradually nearing the shoal water, feeding heavily, and plump with fat and the now swelling ovaries. Later on they appear to eat little or nothing and devote all their time to playing until about the 25th of October, when they have settled down to the business of propagation, which they have finished by November 10. They prefer shallow water close to shore with clean sand to spawn on, and during the day they may be seen in pairs and small schools, poking along the shores, but at night they come in thousands and keep up a constant loud splashing and fluttering, very strange and weird on a calm night. Two years ago I carefully counted the ova from a ripe fish, $2\frac{1}{2}$ pounds in weight, and found there were 23,700, closely resembling whitefish eggs in appearance, but somewhat smaller. After spawning the fish are very thin, lank, dull in color, and quite unfit for human food.

James Annin, Jr., furnished me the following notes on the spawning of the Tullibee in Onondaga Lake, N. Y.

They generally commence running up onto the shoals about November 15, and the season extends into December. They come up to the banks or gravelly shoals and spawn in from 3 to 6 and 7 feet of water. They have never been caught with the hook in this lake; and an old fisherman told me that he had tried almost every kind of bait, and had used the very finest gut and the smallest hooks baited with *Gammarus* (fresh-water shrimp) and other kinds of natural food—that is, he supposed the food was natural to them. At the same time, he claims he could see them in large schools lying in the water 8 or 10 feet from the surface.

A female Tullibee was sent from Onondaga Lake by Mr. Annin November 18, 1895, and another of the same sex November 25, 1896.

The following notes relate to the female obtained November 18, 1895:

	INCHES.
Length to end of caudal, - - - - -	$18\frac{1}{2}$
Length of upper caudal lobe, - - - - -	$2\frac{5}{8}$
Length of middle caudal rays, - - - - -	1
Least depth of caudal peduncle, - - - - -	$1\frac{3}{8}$
Depth of body at dorsal origin, - - - - -	$4\frac{5}{8}$
Length of head, - - - - -	$3\frac{1}{4}$
Length of maxilla, - - - - -	$\frac{7}{8}$
Diameter of eye, - - - - -	$\frac{5}{8}$
Length of longest gill raker, - - - - -	$\frac{9}{16}$

The mandible projects slightly. B. 8; D. 11; A. 11; V. 11. Scales 8-75-8; gill rakers, 17+27.

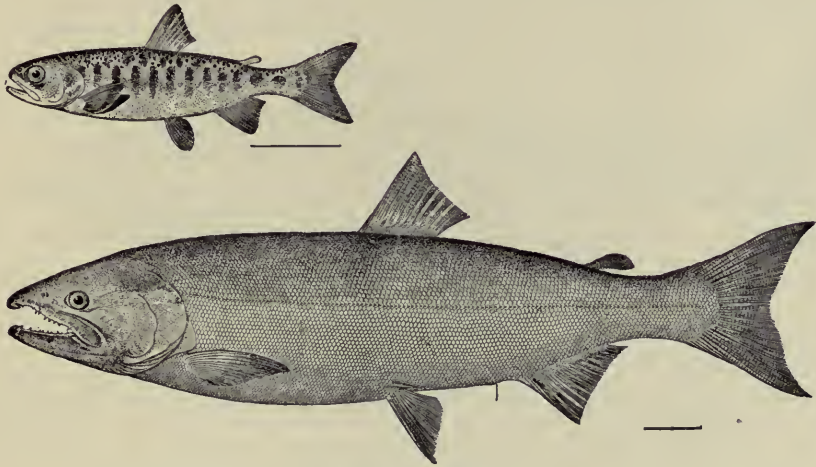
The female received November 25, 1896, is 15 inches long.

57. King Salmon; Quinnat Salmon (*Oncorhynchus tshawytscha* Walbaum).
(Introduced.)

Oncorhynchus chouicha JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 306, 1883; STONE in Fish & Fish. Ind. U. S., I, 479, pl. 186, lower fig., 1884; BEAN, Bull. U. S. F. C., IX, 190, pl. XLVI, fig. 1, 1891; Fishes Penna., 72, 1893.

Oncorhynchus tshawytscha JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus. 479, 1896, pl. LXXVII, fig. 206, 1900.

The Quinnat Salmon is the largest and finest of the Pacific salmon. It ranges from Monterey, Cal., to Alaska and Eastern Asia, ascending rivers in some cases



KING SALMON.

The upper figure is drawn from a young example, four inches long, taken in Alturas Lake, Idaho, September 9, 1895.

1,500 miles or further from the sea. It has been introduced into lakes of New York, but there is no evidence that it has become established in any waters of the State. Possibly better results might be secured if larger fish were selected for the experimental stocking.

This is the largest fish of the Salmon family, individuals weighing 100 pounds and measuring upward of 5 feet in length being on record from the Yukon and other Alaskan rivers. The average weight of adults is above 20 pounds. The flesh of this Salmon is paler in color than that of the Red Salmon, but it is superior in flavor to all others.

The Quinnat is the first to arrive near the shores in the spring, and the time of

the run depends on the latitude, becoming later and later till, in Norton Sound, the present known northern limit of its migration, it appears early in June. Unless the spawning period be close at hand, it does not ascend rivers rapidly, but generally plays around for a few days, or even a couple of weeks, near the river limit of tide-water. It has been estimated that it proceeds up the Columbia River at the rate of 100 miles a month till the exigencies of reproduction compel a faster rate of travel.

In the sea this Salmon feeds on herring, capelin and crustaceans. A male of about 35 pounds, taken at Karluk August 4, had in its stomach 45 capelin. In fresh water the fish take no food.

Spawning takes place near the head waters of streams in clear shallow rapids. The fish excavate oblong cavities in the gravel beds where there is a current, and in these nests the eggs and milt are deposited. The eggs are protected from some of their enemies and fatalities by their environment, but are still a prey to freshets and to the pestiferous little fresh-water sculpins, or blobs, that abound in all trout and salmon waters, so far as observed. The young are hatched in from 60 to 100 days. They are destroyed in large numbers by aquatic birds, blobs and large fishes. The adults are killed by seals, sea lions and sharks. After spawning nearly all the parent fish die, especially those that ascend rivers a long distance.

The Quinnot is a very valuable fish for canning, salting and smoking. If it could be acclimated in the Great Lakes it would form the basis of new and important industries. The practicability of rearing this species in fresh waters without access to the sea has been satisfactorily demonstrated in France by Dr. Jousset de Bellesme, director of the aquarium of the Trocadéro, in Paris.

The results of the experiment of introducing this Salmon into New York waters are as yet unknown, but it is to be hoped that it will be successful. Since the change of method by which larger fish are employed for transplanting the outlook appears to be more favorable.

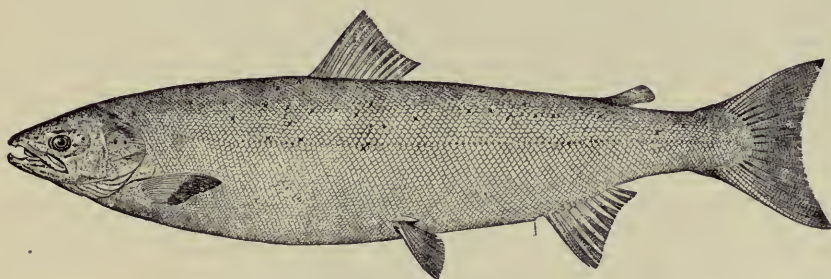
58. Atlantic Salmon (*Salmo salar* Linnæus).

Salmo salar MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 435, 1815; DEKAY, N. Y. Fauna, Fishes, 241, pl. 38, fig. 122, 1842; JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 312, 1883; GOODE, Fish & Fish. Ind. U. S., I, 468, pl. 186, upper fig. 1884; BEAN, Fishes Penna., 74, color pl. 4, 1893; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 486, 1896; BEAN, Bull. Amer. Mus. Nat. Hist., IX, 344, 1897.

The Salmon in America has but a single common name. When the young have reached a length of 2 inches and taken on the vermilion spots and dark cross bands they are called parr, and retain this name while they remain in fresh water. Before

descending to the sea in the second or third spring the parr assumes a bright silvery coat, and is then known as a smolt. After a sojourn in salt water lasting from four months to about two years it may return to its native river, either as a sexually immature Salmon or as a grilse, the female not yet ready for reproducing its species though the male is sexually mature. The landlocked variety of the Atlantic Salmon has been variously denominated Fresh-water Salmon, Schoodic Trout, Sebago Trout, Dwarf Salmon and Winninish, the last in use in the Saginaw region. In some Nova Scotian rivers a misnomer, Grayling, is applied to the Landlocked Salmon.

This species inhabits the North Atlantic, ascending rivers of Europe and America for the purpose of reproduction. In Europe it extends southward to France, and in the United States the most southern river in which specimens have been obtained is the Potomac. It occurs in small numbers in the Delaware and in large numbers in the Hudson, but in the last three river basins mentioned its presence is



ATLANTIC SALMON.

the result of artificial introduction. It is not found in abundance south of the Merrimack, and in rivers of New England and Canada in which it is native it is maintained almost exclusively by artificial culture. Its occurrence in Lake Champlain, the St. Lawrence River, and tributaries of Lake Ontario is due also to modern fish culture. The usual weight of the Atlantic Salmon ranges from 15 to 40 pounds, but individuals weighing 60 pounds have been recorded. The growth of the Salmon is accomplished chiefly in the ocean. As a rule the adults enter the rivers on a rising temperature when ready to deposit their eggs, the spawning occurring on the falling temperature in water not warmer than 50°. The time of entering the Delaware and Hudson is April, the Connecticut a little later, the Merrimack still later; to the Penobscot the Salmon come most abundantly in June and July, and to the Miramichi from the middle of June to October. The Salmon is not much affected by changes in temperature of the water, enduring a range of fully 45°. The eggs are deposited in shoal water on sandy or gravelly bottom, the parent fish making deep depressions by means of their noses or by flopping motions of

the tail. The period of egg-depositing lasts from 5 to 12 days. The spawning season begins about the middle of October and may run into December. In some European rivers the season continues till February. The eggs are about one-fourth of an inch in diameter, and the female is estimated to have about 1,000 for each pound of her weight. In the Penobscot, according to the observations of Mr. Atkins, an eight-pound female yields from 5,000 to 6,000 eggs; and a female of 40 pounds about 15,000 eggs. The hatching period ranges from 140 to 200 days or more, depending on the temperature. A newly hatched Salmon is about three-fourths of an inch long, and the yolk sac is absorbed in from a month to six weeks. It then begins to feed on small organisms in the water. At the age of two months it measures $1\frac{1}{2}$ inches and begins to show crossbars and red spots, gradually coming into the parr stage. In the sea the Salmon feeds on herring, capelin, sand lance, smelt and other small fishes, besides crustaceans; but during its stay in fresh water it takes no food.

Among the worst enemies of salmon eggs are trout, eels, suckers and frogs. Numerous species of birds destroy the fry, among them sheldrakes, kingfishers, gulls and terns.

The value of the Salmon as a food and game fish is so well known as to require no description here. Those that find their way into market are usually caught in pound nets, gill nets or seines, and the bulk of them are taken at or near the mouths of the streams which they are about to enter for the purpose of spawning. Many are captured in the upper reaches of streams by the spear.

Mitchill, in the first volume of the Transactions of the Literary and Philosophical Society of New York, says that the Salmon "has been taken, since the discovery, a few times in the Hudson. But here he is a straggling fish, and not in his regular home. There is no steady migration of Salmon to this river. Though pains have been taken to cherish the breed, the Salmon has never frequented the Hudson in any other manner than as a stray."

In 1842 DeKay published the following note:

The Sea Salmon rarely now appears on our coast except as a straggling visitor. Such an occurrence took place in August, 1840, when a Salmon weighing eight pounds entered the Hudson River, and ascended it more than 150 miles, when it was taken near Troy. * * * It now is only seen on our northern borders, ascending the St. Lawrence from the sea, and appearing in Lake Ontario in April, and leaving it again in October or November. They were formerly very abundant in the lakes in the interior of the State which communicated with Lake Ontario; but the artificial impediments thrown in their way have greatly decreased their

numbers, and, in many cases caused their total destruction. I have seen some from Oneida Lake weighing 10 and 15 pounds. * * * They are occasionally found in Lake Ontario during the whole year; but, as the same instinct which compels them to ascend rivers also leads them again to the sea, and as there is no barrier opposed to their return, we may presume that these are sickly or possibly barren individuals.

Experiments for restocking the Hudson are now in progress, and it is probable that the river may again become a Salmon stream.

59. Landlocked Salmon (*Salmo sebago* Girard). (Introduced.)

Salmo sebago GIRARD, Proc. Ac. Nat. Sci. Phila., 380, 1853, Sebago Lake, Maine.

Salmo salar var. *sebago* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 312, 1883.

Salmo salar sebago JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 487, 1896; BEAN, Bull. Amer. Mus. Nat. Hist., IX, 344, 1897.

There are at least two well marked races of Salar Salmon which do not enter the sea but live permanently in fresh water. Both of these differ from the migratory Salmon in several particulars: they are smaller, their eggs are larger, they retain the parr marks much longer, they are more subject to disease attending the egg-producing season, and the young grow more rapidly. The *Ouananiche* of the Saguenay River country is the farthest removed from the typical Sea Salmon by its very much smaller size, larger fins and different pattern of coloration.

The larger of the two Landlocked Salmon of the United States is found in the four river basins of the State of Maine, the Presumpscot, Sebec, Union and St. Croix. Here the weights vary considerably, spawning fish ranging all the way from 3 pounds to 10 or 12 pounds, while occasional individuals reach 25 pounds. The Sebago form is the one that has been introduced into the Adirondack lakes and other New York waters. Spawning begins late in October, but is at its height in November. Eggs are shipped in January, February and March, and the fry are ready for planting in June.

At Green Lake, Me., the Landlocked Salmon often endure a summer temperature above 80° F., but they refuse to take food when the water reaches 75°.

This Salmon has been introduced into New York waters from Maine, and appears to have become established in several localities. Caspian Lake is one of the lakes that have been stocked. A very fine example was obtained from the South Side Sportsmen's Club of Long Island, but it was injured in transportation and never recovered. In April, 1896, several individuals from Maine were presented by Eugene G. Blackford. One of these lived in a tank of salt water in the New

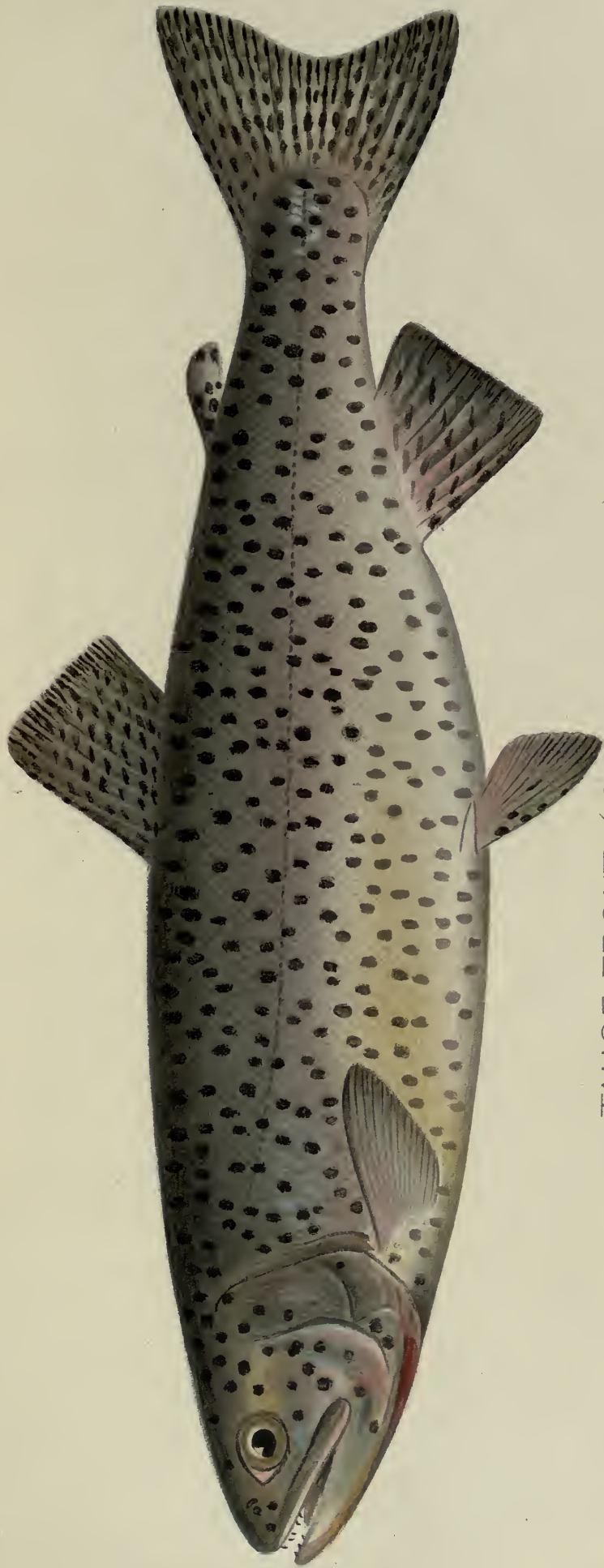
York aquarium for 19 months, and was then frightened by visitors when the water was drawn low for cleaning, and injured itself so badly that it died after a few hours of struggling. The following measurements were obtained from the fresh fish.

INCHES.

Length, - - - - -	24
Middle caudal rays from end of scales, - - - - -	1 $\frac{5}{8}$
Depth, - - - - -	4
Least depth of caudal peduncle, - - - - -	1 $\frac{5}{8}$
Head, - - - - -	4 $\frac{3}{4}$
Snout, - - - - -	1 $\frac{1}{4}$
Eye, - - - - -	$\frac{11}{16}$
Orbit, - - - - -	$\frac{3}{4}$
Snout to dorsal, - - - - -	9 $\frac{1}{2}$
Dorsal base, - - - - -	2 $\frac{3}{4}$
Longest dorsal ray, - - - - -	2 $\frac{3}{8}$
Last dorsal ray, - - - - -	1 $\frac{1}{4}$
Snout to ventral, - - - - -	11 $\frac{1}{4}$
Length of ventral, - - - - -	2 $\frac{1}{4}$
Snout to anal, - - - - -	16 $\frac{3}{8}$
Anal base, - - - - -	1 $\frac{7}{8}$
Longest anal ray, - - - - -	1 $\frac{7}{8}$
Last anal ray, - - - - -	1 $\frac{3}{8}$
Snout to adipose dorsal, - - - - -	17 $\frac{5}{8}$
Width of adipose dorsal, - - - - -	$\frac{1}{2}$
Length of adipose dorsal, - - - - -	$\frac{3}{4}$
Length of pectoral, - - - - -	3 $\frac{1}{4}$
Upper jaw, - - - - -	2 $\frac{1}{4}$
Maxilla, - - - - -	2

The head has about 28 dark spots, the largest on the gill cover, oblong, $\frac{5}{8}$ inch long. Body with many large and small black spots, a few with a pale ring around them, and some as large as the largest on the gill cover; one on the caudal peduncle of one side distinctly X-shaped. General color dark bluish gray; belly and lower parts iridescent silvery; fins all dusky; the dorsal with many black spots; eye pale lemon, the upper part dusky.

Gill rakers, 9 + 11, the longest $\frac{5}{16}$ inch. B. 11; D. 10. Scales, 21-123-20.



TAHOE TROUT (SALMO HENSHAWI).

60. **Lake Tahoe Trout ; Red-throat Trout** (*Salmo henshawii* Gill & Jordan).
(Introduced.)

Salmo henshawii GILL & JORDAN, Man. Vert. ed. 2, 358, 1878, Lake Tahoe ; Rept. Chief Eng., part 3, 1878, App. NN, 1619, pl. IV.

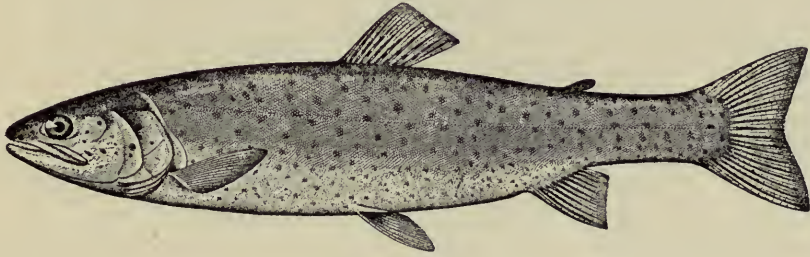
Salmo purpuratus var. *henshawii* JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 316, 1883.

Salmo mykiss CHENEY, Third Ann. Rept. N. Y. Comm. Fish, 239, color pl. facing p. 238, 1898.

Salmo mykiss henshawii JORDAN, Bull. U. S. F. C., IX, 14, pl. II, fig. 5, 1891 ; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 493, 1896.

Salmo clarkii henshawii JORDAN & EVERMANN, op. cit. 2819, pl. LXXIX, fig. 208, 1900.

Body elongate, not much compressed, its greatest depth one-fourth of the total length without caudal ; caudal peduncle rather long, its least depth equaling two-fifths of the length of the head ; head long, conical, slender, its length contained about four times in the total to caudal base ; a slight keel on the top of the head ;



LAKE TAHOE TROUT.

snout obtusely pointed ; maxilla not extending far behind the eye, about equal to pectoral, which is three-fifths of length of head ; gill rakers short and stout, about 18 on the first arch, of which 13 are below the angle ; vomerine teeth in two long, alternating series ; hyoid teeth rather weak, in a small patch ; dorsal fin small, its last rays two-thirds as long as the highest ; anal fin rather high ; caudal short and distinctly forked. D. 9 to 11 ; A. 12 ; B. 10. Scales 27 to 37-160 to 200-27 to 40 ; pyloric cæca 50 to 60.

Color dark green in life, varying to pale green ; the sides silvery with a broad coppery shade which extends also on the cheeks and opercles ; a yellowish tinge on the sides of the lower jaw and red or orange dashes between its rami ; back everywhere covered with large, roundish black spots ; dorsal, adipose fin and caudal fin with similar spots, and a few on the anal ; belly with black spots.

The Tahoe Trout is a large species inhabiting Tahoe Lake, Pyramid Lake, Weber Lake, Donner Lake, Independence Lake, Truckee River, Humboldt River, Carson River, and most streams of the east slope of the Sierra Nevada ; it occurs

also in the head waters of Feather River, west of the Sierra Nevada, probably by introduction from Nevada.

The usual weight is 5 or 6 pounds, but individuals weighing 20 to 29 pounds are recorded.

Eggs of the Lake Tahoe, Cal., Trout were obtained by James Annin, Jr., at Caledonia, N. Y., and young fish reared at his establishment were sent to the aquarium in November, 1896. They thrive till the latter part of June, 1897, when they were overcome by the warm water. They could not endure a transfer to the cooler salt water, like most of the other fish of the Salmon family.

At Caledonia Station, according to Mr. Cheney, this fish begins to spawn before the middle of March, and continues for two months. The impregnation of eggs is from 90% to 95%, but just before the hatching period a large number of the eggs burst and the embryos are lost. There is loss too between the hatching and feeding times, and the fry do not feed as readily as the Brook Trout. Altogether, Mr. Annin, the superintendent of hatcheries, estimates the total loss between impregnation of the eggs and feeding of the fry as about 40%. After the fry begin to feed they are not more difficult to rear than Brook Trout.

61. Steelhead; Gairdner's Trout; Salmon Trout (*Salmo gairdneri* Richardson).
(Introduced.)

Salmo gairdneri JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 313, 1883; BEAN, Bull. U. S. F. C., IX, 198, pl. XLIX, fig. 9, 1891, not fig. 10, which is young *mykiss*; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 498, 1896, pl. LXXXI, fig. 215, 1900; CHENEY, Third Ann. Rept. N. Y. Comm. Fish, 241, color pl., 1898.

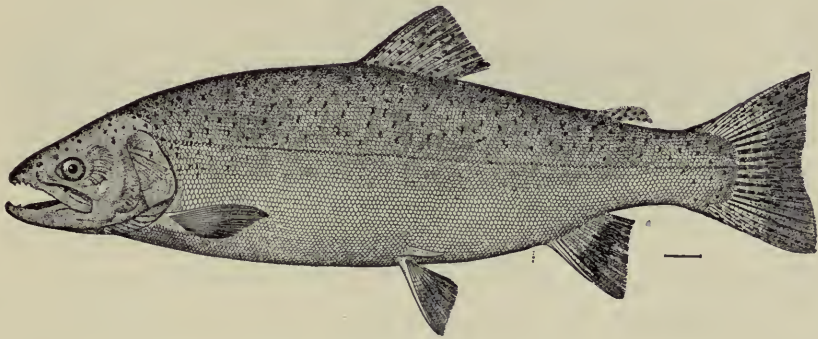
Form of *S. salar*. Body elongate, little compressed, its greatest depth two-ninths of the total length without caudal; caudal peduncle short, its least depth three-sevenths of length of head; head rather short, one-fifth of total length without caudal, maxilla reaching far behind the eye, its length one-half the length of head; eye small, two-thirds of length of snout, two-elevenths as long as the head; teeth rather small, vomerines in two long, alternating series about as long as the palatine series; gill rakers short and stout, about 20 on the first arch, of which 12 are below the angle; dorsal origin much nearer to tip of snout than to base of caudal, base of dorsal two-thirds of length of head, longest dorsal ray one-half the length of head and twice as long as last ray; adipose fin very small and narrow, over the beginning of the anal; caudal fin moderately forked in the young; ventral origin midway between tip of snout and base of caudal, ventral fin one-half the depth of body; anal base one-half as long as the head, longest anal ray equal to postorbital part of

head; pectoral fin one-eighth of total length without caudal. B. 11 or 12; D. 11; A. 12. Scales from 137 to 177, usually about 150-28; pyloric cæca 42; vertebrae $38+20=58$. Color olive green above, sides silvery, head, back, dorsal and caudal fins profusely covered with small black spots, no red between the rami of the lower jaw.

The Steelhead Trout is found in coastwise streams from Southern California to Bristol Bay, Alaska. It spawns in the late winter and early spring; ripe eggs were obtained at Sitka, Alaska, June 10. Spent fish of this species are frequently taken with the spring run of the King Salmon.

The economic value of the Steelhead is very great; the fish reaches a weight of 30 pounds, though the average weight is under 20 pounds, and the non-anadromous forms seldom exceed 5 or 6 pounds.

From information furnished by Mr. Annin it appears evident that some of the eggs of Trout received at Caledonia, N. Y., many years ago from the McLeod River,



STEELHEAD.

Cal., as Rainbows, really included both Rainbows and Steelheads. He finds certain females producing deep salmon-colored eggs while in the same pond and receiving the same food as other females which furnish very light-colored, almost white, eggs. Some of the females also differ from others in going to the spawning beds nearly two months earlier. It is now known also that the McLeod contains a small-scaled form of the Rainbow, known to the Indians as the *no-shee*, and this also may easily have been sent to the east under the name of Rainbow. Striking differences in the appearance and habits of so-called Rainbows introduced into the various States lend color to this supposition.

Steelheads were obtained for the New York aquarium in November, 1896, from the U. S. Fish Commission. They were hatched from eggs shipped from Fort Gaston, Cal., to the station at Craig Brook, Me. The length of the trout when received ranged from 4 to $4\frac{1}{2}$ inches. After one year they were 10 inches long on

the average, and weighed many times as much as they did when received. None of them at any time showed a red lateral band such as is present in the Rainbow, and they are farther distinguished by the presence of white tips on the ventral and anal fins; the dorsal also has a small white tip. They have been kept almost from their arrival in salt water, and could not have been kept in the warm Croton water in June. The salt water never rose above $71\frac{1}{2}^{\circ}$ F. and continued at this high temperature only 10 days.

The N. Y. Fisheries, Game and Forest Commission planted some of these trout in a Long Island stream and some in a lake in Northern New York. Those that were planted on Long Island, says Mr. Cheney, when rather more than a year old rose to the fly of the trout fisherman and made a most gallant fight, but it is too early to tell the outcome of the experiment. The eggs are one-fifth of an inch in diameter; they hatch in 42 to 50 days with water at 50° .



BROWN TROUT.

62. Brown Trout (*Salmo fario* Linnæus). (Introduced.)

Salmo fario BEAN, Fishes Penna., 78, color pl. 6, 1893; JORDAN & EVERMANN, Check-List Fish. N. A., 512, 1896.

Salar ausonii CUVIER & VALENCIENNES, Hist. Nat. Poiss., XXI, 319, pl. 618, 1848.

The Brown Trout of Europe was introduced into the United States from Germany in February, 1883, and in subsequent years; it has now become thoroughly acclimated in the fresh waters of many of the States.

The body of this trout is comparatively short and stout, its greatest depth being contained about four times in the length without the caudal. The caudal peduncle is short and deep, its depth equal to two-fifths of the length of the head. The length of the head in adults is one-fourth of the total length without caudal or slightly less. The diameter of the eye is about one-fifth of the length of the head, and less than length of snout. The dorsal fin is placed nearer to the tip of the snout than to the root of the tail; the longest ray of this fin equals the distance from the

eye to the end of the opercle. The ventral is under the posterior part of the dorsal; its length is about one-half that of the head. The adipose dorsal is placed over the end of the anal base; it is long and expanded at the end. The caudal is emarginate in young examples, but nearly truncate in specimens 10 inches long. The pectoral is nearly one-sixth of the length without the caudal. In the male the jaws are produced, and very old ones have a hook. The maxilla extends to the hind margin of the eye. The triangular head of the vomer has a transverse series of teeth, and the shaft of the bone bears two opposite or alternating series of strong persistent teeth. D. 13-14; A. 10-11; P. 13; V. 9. Scales 25-20-30; pyloric cæca 38-51; vertebrae 57-58.

On the head, body and dorsal fin usually numerous red and black spots, the latter circular or X-shaped and some of them with a pale border; yellowish margin usually present on the front of the dorsal and anal and the outer part of the ventral. The dark spots are few in number below the lateral line. The ground color of the body is brownish or brownish black, varying with food and locality.

Names. In European countries in which this species is native it bears the name of trout or brook trout or the equivalents of these terms. In Germany it is *bachforelle*; in Italy, *trota*; in France, *truite*. In the United States it is known as the Brown Trout and von Behr trout, the latter in honor of Herr von Behr, president of the Deutscher Fischerie Verein, who has been very active in the acclimation of the fish in America.

Distribution. The Brown Trout is widely distributed in Continental Europe and inhabits lakes as well as streams, especially in Norway and Sweden. Tributaries of the White Sea, the Baltic, the Black Sea and the Caspian contain this species. In Great Britain it lives in lakes and streams and has reached a high state of perfection; in Germany and Austria, however, the Trout is a characteristic fish, and our supply has been drawn principally from the former country. Moreau found it at an elevation of 7,000 feet in the Pyrenees, and a color variety is native to Northern Algeria in about 37° north latitude. In the United States the Brown Trout has been successfully reared in Colorado at an elevation of nearly 2 miles above sea level; it is now well established in New York, Pennsylvania, Maryland, Missouri, Michigan, Wisconsin, Nebraska, Colorado, and several other States. This Trout has proved to be well adapted to the region east of the Rocky Mountains, which has no native black spotted species, though the western streams and lakes contain many forms in a high state of development.

Size. Under favorable conditions the Brown Trout has been credited with a weight of 22 pounds and a length of 35 inches. In New Zealand rivers, where it

was introduced with unusual success, it now approximates equal size; but in most localities 10 pounds is about the limit of weight and 5 or 6 pounds is a good average, while in some regions the length seldom exceeds 1 foot, and the weight ranges from $\frac{1}{2}$ pound to 1 pound. In the United States a wild specimen, seven years old, weighed about 11 pounds. In a well in Scotland an individual aged 15 years measured only about 1 foot in length. These illustrations will serve to show how much the growth of a Brown Trout is affected by its surroundings and food supply. The species has been known to become sexually mature when two years old and 8 inches long.

Habits. The Brown Trout thrives in clear, cold, rapid streams and at the mouths of streams tributary to lakes. In its movements it is swift, and it leaps over obstructions like the Salmon. It feeds usually in the morning and evening, is more active during evening and night, and often lies quietly in deep pools or in the shadow of overhanging bushes and trees for hours at a time. It feeds on insects and their larvæ, worms, mollusks and small fishes, and, like its relative, the Rainbow Trout, it is fond of the eggs of fishes. In Europe it is described as rising eagerly to the surface in pursuit of gnats, and is said to grow most rapidly when fed on insects.

Reproduction. Spawning begins in October and continues through December and sometimes into January. The eggs are from one-sixth to one-fifth of an inch in diameter and yellowish or reddish in color; they are deposited at intervals during a period of many days in crevices between stones, under projecting roots of trees, and sometimes in nests excavated by the spawning fishes. The parents cover the eggs to some extent with gravel. The hatching period varies according to temperature from 40 to 70 days. Females aged three years furnish on the average about 350 eggs each, but individuals of this age have yielded as many as 700, and even at the age of two years some females produce from 400 to 500. When they are four or five years old, the number of eggs has reached 1,500 to 2,000. The young thrive in water with a temperature of about 50° F. Sterility in the females is common, and breeding females have been observed to cease reproduction when eight years old.

Qualities. The Brown Trout is in its prime from May to the last of September. Its flesh is very digestible and nutritious, and deeper red than that of the Salmon when suitable food is furnished; the flavor and color, however, vary with food and locality. Insect food produces the most rapid growth and best condition. This species has been so long known as one of the noblest of the game fishes and its adaptability for capture with artificial flies because of its feeding habits is so well understood that I need not dwell on these familiar details.

63. Hybrid Trout (Brown and Brook).

A very beautiful and interesting hybrid is produced by crossing the Brown Trout and the Brook Trout. The following is a description of this hybrid :

Salmo (HYBRID=fario+fontinalis)

Hybrid Trout.

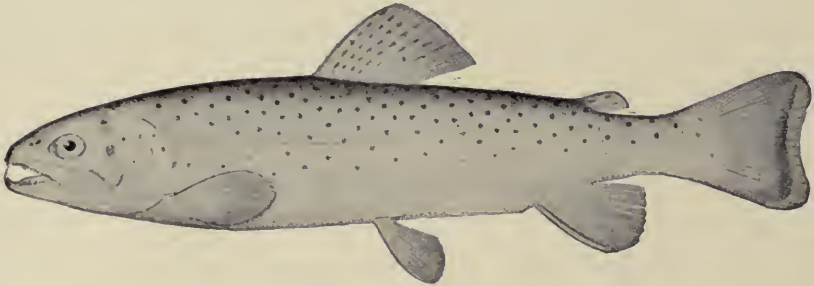
In a paper published some years ago the writer stated, as a result of his studies, that when a large-scaled trout is crossed with a small-scaled one, the hybrid will be large-scaled whichever way the cross be made. The hybrid between the Brown Trout and the Brook is a large-scaled form, and it is sterile as far as reported. The New York aquarium has had this hybrid from the South Side Sportsmen's Club and from the New York hatcheries at Coldspring Harbor, L. I., and Caledonia. It is always a strikingly handsome fish, and grows to a large size ; but it is far less hardy than either of its parents. The cross has always been artificially made, and never occurs naturally. Two specimens studied gave the following measurements in inches :

MEASUREMENTS.

	CALEDONIA, N. Y. JUNE 10, 1896. JAMES ANNIN, JR.	OAKDALE, N. Y. MARCH 23, 1897. G. P. SLADE.
Extreme length, - - - - -	9¼	14¼
Length of middle caudal rays from end of scales,	¾	
Depth of body, - - - - -	1⅞	3⅞
Least depth of caudal peduncle, - - -	⅞	
Length of head, - - - - -	2	3¼
Length of snout, - - - - -	½	1⅞
Length of upper jaw, - - - - -	1¼	
Length of lower jaw, - - - - -	1⅜	
Diameter of eye, - - - - -	5/16	7/16
Distance from snout to dorsal origin, - -	3¾	
Length of dorsal base, - - - - -	13/16	
Length of longest dorsal ray, - - - - -	15/16	
Length of last dorsal ray, - - - - -	¾	
Distance from snout to ventral origin, - -	4½	
Length of ventral, - - - - -	1⅞	
Distance from snout to anal origin, - - -	6	
Length of anal base, - - - - -	⅞	
Length of longest anal ray, - - - - -	1¼	
Length of last anal ray, - - - - -	½	

The Caledonian specimen has no hyoid teeth; the vomerines are in a very small patch on the head of the bone only. The gill rakers are 4+10, the longest about one-half the diameter of the eye. It has about 124 tubes in the lateral line. Branchiostegals, 10. The following color notes were taken from the fresh fish: Dorsal fin with numerous dark blotches resembling those of young rainbow; adipose long and slender, amber color with two obscure dusky blotches, one of these very indistinct; lower half of sides pink; ventral, anal and caudal pink; ventral and anal with a milk white front margin, that in the anal limited behind by a dark line as in Brook Trout; sides reticulated with large meshes of lemon yellow interspersed with darker purplish or olive. Dorsal blotches are mingled with pale lemon. Pectoral pale vermilion. Eye silvery white with yellowish reflections.

The specimen from Oakdale, L. I., weighed 20 ounces. It has a triangular patch of vomerine teeth, as found in *fontinalis*, but continued behind by several teeth in a single row, the entire length of the vomerine series being seven-sixteenths of an inch.



LOCH LEVEN TROUT.

64. **Loch Leven Trout** (*Salmo trutta levenensis* Walker). (Introduced.)

Salmo levenensis WALKER, Wern. Mem., I, 541, 1811; YARRELL, Brit. Fish., ed. 2, II, 117, 1841; ed. 3, I, 257, fig. 1859; GUNTHER, Cat. Fish. Brit. Mus., VI, 101, 1866; DAY, Fish. Great Brit. & Ireland, II, 92, pl. CXVI, fig. 2 & 2a, 1884; BAIRD, Rept. U. S. F. C., XII, LVIII, 1886.

Salmo trutta levenensis JORDAN & EVERMANN, Check-List Fish. N. A., 512, 1896.

The Loch Leven Trout of Great Britain was introduced into the United States from Scotland in 1885 and subsequent years. It is somewhat closely related to the European Brown Trout, *Salmo fario*, and has been artificially crossed with that species in the United States, so that it is sometimes difficult to find the pure bred Loch Levens in fishcultural establishments at home.

The body of the Loch Leven is more slender and elongate than that of the Brown Trout, its greatest depth contained four and one-fourth to four and one-half times in the total length without caudal. Caudal peduncle slender, its least depth

three-eighths of the greatest depth of the body, and equal to length of snout and eye combined. The head is rather short and conical, its length two-ninths to one-fifth of the total length without caudal. The snout is one-fourth or slightly more than one-fourth as long as the head. The interorbital space is somewhat convex, its width equal to three-fifths of the length of postorbital part of head. The eye is of moderate size, its long diameter contained five and one-half to six times in the length of the head, and equaling about twice the greatest width of the maxilla. The maxilla reaches to or slightly beyond the hind margin of the eye. Teeth rather strong, those in the intermaxillary and mandible the largest, triangular head of vomer with two or three in a transverse series at its base, teeth on the shaft of the vomer usually in a single, partially zigzag, persistent series. Mandible without a hook and little produced even in breeding males. Dorsal origin distant from tip of snout about as far as end of dorsal base from base of caudal; the dorsal fin higher than long, its base one-eighth of total length without caudal, its longest ray equal to longest ray of anal fin. The anal fin is much higher than long, its distance from the base of the ventral equaling length of the head. The ventral origin is nearly under the middle of the dorsal, the fin being as long as the postorbital part of the head. Pectoral equals length of head without the snout. Adipose fin very small, its width one-half its length, which is about equal to eye. Caudal fin emarginate unless fully extended, when it becomes truncate, the outer rays about one-seventh of total length, including caudal. D. 13 (= iv, 9); A. 12 (= iii, 9); P. 14; V. 9. Scales 24 to 28—118 to 130—26 to 30; pyloric cæca 47 to 90; vertebrae 56 to 59.

Upper parts brownish or greenish olive, or sometimes with a reddish tinge, sides silvery with a varying number of x-shaped black spots, or sometimes rounded brown spots or rounded black spots which may be ocellated; occasionally red spots are seen on the sides, and the adipose fin may have several bright orange spots, or it may show a red edge and several dark spots; sides of the head with round black spots; dorsal and adipose fins usually with numerous small brown spots; tip of pectoral blackish; anal and caudal fins unspotted, but the caudal sometimes has an orange margin and the anal a white edge with black at its base; a similar edge may sometimes be observed on the ventral.

The Loch Leven Trout is a non-migratory species, inhabiting Loch Leven and other lakes of Southern Scotland and of the North of England. Its range in Great Britain and on the Continent of Europe has been greatly extended by fishcultural operations, and the fish is now fairly well known in the United States, though mixed to some extent with the Brown Trout, as remarked above.

The Loch Leven Trout has been recorded of the weight of 18 pounds, but the average weight at 6 years of age is about 7 pounds, though some individuals of that age may reach 10 pounds. The natural food of this species includes fresh-water mollusks (snails, *Buccinum*, etc.), crustaceans, worms and small fish. In captivity it is reared on liver, horse flesh, chopped clams and various other meats.

As a food fish the Loch Leven is highly esteemed on account of the red color and the delicate flavor of its flesh when obtained from suitable waters; in some localities the flesh often becomes white from lack of food or improper food.

The spawning season may begin late in September or early in October and continue till December. In Michigan it corresponds with that of the Brook Trout. The egg varies from about one-fifth to one-fourth of an inch in diameter. A Trout weighing 2 pounds contained 1,944 eggs, the weight of which was one-half pound.

The Loch Leven will take the artificial fly as readily as the Brown Trout and the Brook Trout. Its great size and strength add to its attractions for the angler.



RAINBOW TROUT—ADULT MALE.

65. Rainbow Trout (*Salmo irideus* Gibbons). (Introduced.)

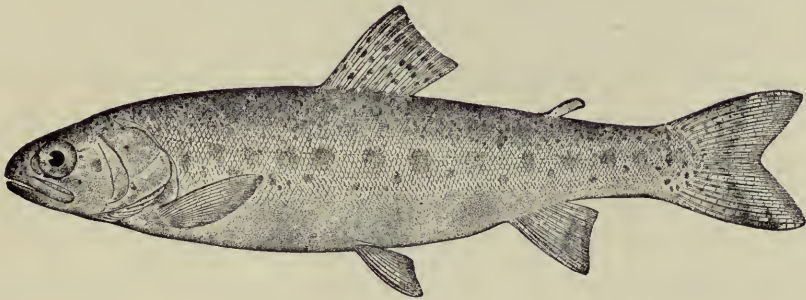
Salmo irideus GIBBONS, Proc. Cal. Ac. Nat. Sci., 36, 1855, San Leandro Creek, Alameda County, Cal.; JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 312, in part, 1883; BEAN, Bull. U. S. F. C., XII, 36, pl. V, figs. 2 & 3, 1894; Fishes Penna., 77, color pl. V, 1893; Ann. Rept. N. Y. Comm. Fish, etc., I; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., pl. LXXXI, fig. 216, 1900.

Salmo irideus shasta JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 502, 1896.

Body short and deep, its greatest depth equaling two-sevenths of the total length without caudal. The least depth of caudal peduncle equals one-half the length of head. The head is short and deep; its length is contained about four and two-thirds times in the total length without the caudal. The snout is short, not much longer than the eye, about one-fourth the length of head. Diameter of the eye contained four and two-thirds times in length of head; maxilla not quite reaching

to below hind margin of eye; vomerines in two irregular series; gill rakers about 20. Dorsal origin a little nearer tip of snout than to caudal base. The length of the dorsal base is contained seven and one-half times in total without caudal, and slightly exceeds longest dorsal ray; last dorsal ray one-half as long as the longest. Ventral origin is under middle of dorsal base; the fin is as long as the longest dorsal ray; the ventral appendage about as long as the eye; when the ventral is extended, the distance of its tip from the vent is one-third of length of head. The anal base is a little more than one-half as long as the head; the longest anal ray equals the longest dorsal ray; the last ray is not quite so long as the eye. Adipose fin short, its width nearly equal to its length and two-thirds of diameter of eye. B. 11; D. 11 divided rays and 4 rudiments; A. 10 divided rays and 3 rudiments. Scales 21—135 to 140—20.

The upper parts usually greenish blue, sometimes purplish; the sides more or less silvery and profusely spotted with small black spots, which are most numerous



RAINBOW TROUT—YOUNG.

above the lateral line; head, dorsal, adipose, and caudal fins also black spotted. Sea-run specimens are uniform silvery without black spots. In the breeding season the broad crimson lateral band becomes brighter, and the sides of both sexes are iridescent purplish. The jaws of the male in the breeding season are not much distorted, but they are very much larger than in the female.

The Rainbow Trout is a native of the mountain streams of the Pacific coast and ranges from California to Southern Alaska. A small example was taken at Sitka, in 1880, by Admiral L. A. Beardslee, U. S. N., and is now in the collection of the U. S. National Museum. This trout is found chiefly in mountain streams west of the Sierra Nevadas. It rarely descends into the lower stretches of the rivers, but occasionally does so and passes out to sea. The Rainbow has been extensively introduced into many Eastern States, but not with uniform success. In Wisconsin, Michigan, Missouri and North Carolina it has been well acclimatized, and it is also fairly established in New York.

The average individuals of this species are less than 1 foot in length, but specimens measuring more than 2 feet and weighing 13 pounds have been recorded. At Neosho, Mo., the young have been artificially grown to a length of nearly 1 foot in a year.

The Rainbow feeds on worms, insect larvæ and salmon eggs. In streams in which the California Salmon and Rainbow exist together, the Rainbow is more destructive to the salmon eggs than any other species. Spawning takes place in winter and early spring, varying with temperature and locality. The bulk of the eggs are usually taken in January, February and March, and the average yield from each female is about 900 eggs. A few of the females spawn when two years old, but about one-half of them begin at three years. The egg is from one-fifth to two-ninths of an inch in diameter; it has a rich cream color when first taken, changing to pink or flesh color before hatching.

The Rainbow will live in water of a much higher temperature than the Brook Trout will endure and it thrives in tidal streams and even in salt water. On Long Island, for example, the South Side Sportsmen's Club obtains a great deal of fine sport with this trout in the estuary of its trout brook. The flesh of the Rainbow is generally much esteemed, and in most localities the game qualities of the fish are scarcely inferior to those of the Brook Trout.

Large Rainbow Trout do not stand transportation well when ice is used to cool the water in which they are carried. They frequently injure their eyes, and become blind soon after the end of a journey. They are inveterate fighters, and the strongest invariably rules and harasses the rest. Contrary to what has been stated heretofore, they will not endure high temperatures as well as the Brook Trout, at least in the aquarium.

66. Swiss Lake Trout (*Salmo lemanus* Cuvier). (Introduced.)

Salmo lemanus CUVIER, Régne Anim. *vide* Günther; GÜNTHER, Cat. Fish. Brit. Mus., VI, 81, 1866.

Salmo trutta JURINE, Mém. Soc. Phys. Genève, III, 1, 158, pl. 4, 1825.

Fario lemanus CUVIER & VALENCIENNES, Hist. Nat. Poiss., XXI, 300, pl. 617 (male), 1848.

Swiss Lake Trout ATKINS, Rept. U. S. F. C., XVII, XVIII, XIX, 1893 and 1894.

Head well proportioned in its shape, of moderate size, body rather stout; preoperculum with a distinct lower limb, operculum rather broad and high; snout of moderate length, rather produced in the male sex, in which a mandibular hook is developed in the spawning season; maxillary longer than the snout, and at least as

strong and broad as in *S. fario*; in specimens 12 inches long it extends somewhat behind the vertical from the hind margin of the orbit. Teeth moderately strong, those on the vomer in a single series, alternately bent toward the right and left, persistent throughout life. Pectoral fin rounded, its length being less, and in young individuals more than, one-half of its distance from the ventral. The caudal becomes truncate with age; in specimens of from 12 to 15 inches in length it is emarginate, the middle rays being half as long as the outer ones. The hind part of the body of moderate depth; there are 13 or 14 scales in a transverse series descending from behind the adipose fin forward to the lateral line.

Back greenish, sides and belly silvery, numerous very small X-shaped black spots on the sides; opercles and dorsal fin with numerous black dots; the other fins greenish. D. 13; A. 12; P. 14; V. 9. Scales 26 to 28—115 to 128—36; pyloric cæca 45—52; vertebrae 57 (once), 58—59. (After Günther.)

Attempts have been made from time to time to introduce into large, cold lakes of the United States the fine Lake Trout of Lake Geneva, Switzerland. Eggs have been furnished to the U. S. Fish Commission by the Swiss government, and these were hatched at the Craig Brook, Me., station, and from there the young were distributed to lakes believed to be suitable for the experiment. In New York, the Adirondack League Club obtained 1,000 of the young of this species in 1896 and deposited them in Green Lake, in Herkimer County. The specimen described below is probably one of the results of that experiment. Swiss Lake Trout were furnished also to the New York Fish Commission for planting in Lake George, and 100 yearlings were presented to the New York Aquarium.

A specimen taken in Green Lake, Adirondack League Club preserve, Herkimer County, July 29, 1899, was forwarded to the U. S. Fish Commission, Washington, D. C., and there described by Dr. W. C. Kendall, from whose notes the following account is drawn.

The total length of the specimen is $11\frac{3}{8}$ inches. When first taken it was reported to measure $11\frac{3}{4}$ inches. The body is moderately elongate, its greatest depth contained three and three-fifths times in the total length to base of caudal. Head large, slightly more than one-third of total length to base of caudal; eye rather large, about one-fifth of length of head; snout long, about three-tenths of length of head; teeth on jaws, palatines and tongue long, curved and sharp, those of the lower jaw longest, shaft of vomer long with a zigzag row of sharp teeth; gill rakers short, the longest one-third of diameter of iris, 4+11 on right side, 5+10 on left side. Height of longest dorsal ray two-thirds of length of head. Pectoral five-eighths as long as the head. B. 11-12; D. 9; A. 8. Scales in lateral line 115.

General appearance of *Salmo salar sebago*, from which it would probably not be distinguished by the casual observer if caught where the Landlocked Salmon occurs; but the *lemanus* is distinguishable by the heavier appearance forward of the dorsal fin.

Color in spirits, brownish on back, top of head and sides of head; sides and belly very silvery; large roundish black spots above lateral line forward and on cheeks and opercles; perpendicularly elongate spots forward below lateral line; black of all spots most intense on edges of scales; posteriorly the spots show only on the edges of the scales, being variously crescentic, double or triple crescentic, X or double X-shaped; fins pale with slightly dusky tinge; dorsal with 5 transverse rows of black spots.

Mr. De Witt, who sent the specimen, furnished the following notes on Green Lake, from whence it was forwarded: "Maximum depth 42 feet, with temperature at bottom at that depth, as far as I have been able to ascertain, about 40°. Has no outlet so far as we know. No Brown Trout have ever been put in it, and we take it for granted that the specimen I send is one of the Swiss Trout."



LAKE TROUT.

67. Lake Trout; Salmon Trout (*Cristivomer namaycush* Walbaum).

Salmo amethystinus MITCHILL, Jour. Ac. Nat. Sci. Phila., I, 410, 1818.

Salmo confinis DEKAY, N. Y. Fauna, Fishes, 238, pl. 38, fig. 123, 1842.

Salmo amethystus DEKAY, op. cit. 240, pl. 76, fig. 241.

Salvelinus namaycush JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 317, 1883; GOODE, Fish. & Fish. Ind. U. S., I, 485, pl. 191B, 1884; BEAN, Fishes Penna., 82, color pl. 8, 1893.

Cristivomer namaycush JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 504, 1896, pl. LXXXII, fig. 217, 1900; BEAN, Bull. Amer. Mus. Nat. Hist., IX, 348, 1897.

The Lake Trout or Namaycush has a stout and moderately elongate body. The caudal peduncle is slender; its height little more than one-third of the greatest height of the fish. The eye is large, placed near the top of the head, two-thirds as

long as the snout, and contained four and a half to five and a half times in length of head. The maxilla reaches far behind the eye; its length nearly half that of head. The origin of the dorsal is midway between tip of snout and root of tail. The length of the base equals length of maxilla; its longest ray one-sixth of total without caudal. The ventral is under the hind part of dorsal; its length half the length of head. The appendage is very short, about half the length of eye. The fin, when extended, reaches nearly to the vent. The distance between ventral origin and anal origin is one-fifth of total length without caudal. The anal base is about one-third of length of head; the longest ray half of length of head; the last ray equal to eye. The pectoral is nearly two-thirds as long as the head. B. 11 to 12; D. 9 to 10, besides several rudiments; A. 9 and several rudiments; V. 9. Scales of lateral line about 200.

The coloration is extremely variable, generally grayish, in the variety known as the Tuladi, nearly black. Alaskan specimens are usually very dark; occasionally the upper parts are pale. The sides are profusely covered with roundish pale spots, sometimes with a reddish tinge. On the back and top of head there are fine vermiculations resembling those of the Brook Trout. The caudal, in addition to numerous pale spots, has many small dark blotches.

The Lake Trout has received many names, among which are the following: Mackinaw, Namaycush, Togue, Tuladi and Salmon Trout. Additional names of the species are Lunge, Red Trout, Gray Trout, and Black Salmon. Togue and Tuladi are names applied in Maine, New Brunswick and Canada, Mackinaw and Salmon Trout in the Great Lakes region, the latter used also in New York. Namaycush is of course an Indian name.

The Lake Trout is native in the Great Lakes region, lakes of New York and New England, Idaho and northward into Labrador, British America and Alaska. Extending over such a wide range of country, it varies greatly in size, form and color, which will in part account for the various names which it has received. It has been found above the Arctic Circle in Alaska.

This is one of the largest species of the Salmon family resident in fresh waters. It reaches a length of 3 feet, and specimens weighing 40 pounds are not uncommon. It is said that an example of 90 pounds and 6 feet in length has been taken. The species is found in its best condition in Lakes Huron, Michigan and Superior. In Alaska it grows to a large size, and is a very shapely and beautifully colored fish.

The Lake Trout is one of the most rapacious fishes of its family. In Lake Michigan it feeds largely on the Cisco and other small Whitefishes. At Two Rivers, Wis., a Lake Trout measuring 23 inches was found to contain a Burbot about 17

inches long. The gluttony of this species is proverbial. It will devour table refuse, and materials of this kind have frequently been taken from its stomach. Even twigs, leaves and pieces of wood have been taken by this Trout. The species is much more sluggish in its habits than the Brook Trout, and is taken on or near the bottom. The gill and pound nets in which this species is principally captured are set in deep water.

The spawning of the Lake Trout usually begins in October and continues into November. For this purpose they come up on rocky shoals and reefs in depths of from 70 to 90 feet, and spawn near the edges of rock caverns, into which the eggs settle. The young are hatched late in the winter or early in spring. In some localities the depth of the spawning areas ranges from 15 fathoms to only 7 feet. Mr. Milner found 14,943 eggs in a Lake Trout weighing 24 pounds. In the hatchery, with a water temperature of 47°, the young hatch about the last week of January, but their hatching may be retarded several weeks by lower temperatures.

The fishery for the Lake Trout is most active in September, October and November, and the fish are taken chiefly in pound and gill nets. In some regions many of them also are caught with hooks. In Lake Erie a few large trout of this species, weighing from 25 to 40 pounds, are taken off the city of Erie. In 1885, according to the statistics of the U. S. Fish Commission, 100,000 pounds of Lake Trout were taken in Erie County, Pa.

Hon. H. W. Sage is authority for the information that the Lake Trout was formerly common in the lake near Ithaca. About 1830 a large individual was found stranded in Cayuga Lake Inlet, about 1½ miles from the lake.

68. Brook Trout (*Salvelinus fontinalis* Mitchill).

Salmo fontinalis MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 435, 1815, near New York; RICHARDSON, Fauna Bor.-Amer., III, 176, pl. 83, fig. 1, 1836; DEKAY, N. Y. Fauna, Fishes, 235, pl. 38, fig. 120, 1842.

Salmo erythrogaster DEKAY, N. Y. Fauna, Fishes, 236, pl. 39, fig. 136, 1842.

Baione fontinalis DEKAY, op. cit. 244, pl. 20, fig. 58, 1842.

Salvelinus fontinalis GOODE, Fish. & Fish. Ind. U. S., I, 497, pl. 192, 1884; BEAN, Fishes Penna., 80, color pl. 7, 1893; Bull. Amer. Mus. Nat. Hist., IX, 350, 1897; BOWERS, Manual Fish Cult., ed. 2, color pl. frontispiece, 1900; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 506, pl. LXXXII, fig. 218, 1900.

The Brook Trout varies greatly in the shape of the body, which is sometimes short and deep and again elongate and moderately thin. The depth is usually about one-fourth or two-ninths of total length without caudal, and about equal to

length of head. The least depth of the caudal peduncle is a little more than one-third of its greatest depth. The head is large and the snout somewhat obtuse. The eye is in front of the middle of its length, a little more than one-half as long as the snout, and about one-sixth of length of head. The dorsal fin is about midway between tip of snout and root of tail. The length of its base equals about half its greatest depth of body. The longest ray equals length of ventral. The ventral origin is a little behind the middle of the dorsal. In the male, when laid backward, it reaches nearly to the vent. The length of the appendage equals that of the eye. The anal base is two-thirds as long as the ventral, its longest ray equal to ventral. The adipose-fin is short and stout, its width two-thirds of its length and about two-thirds of length of eye. D. 10; A. 9. Scales in lateral line 225 to 235; six gill rakers above the angle of the first arch, 11 below.



BROOK TROUT.

The coloration is highly variable with age and locality. The upper parts are usually grayish, much mottled with dark olive or black. The dorsal fin and anterior part of caudal base and top of head are also mottled. The caudal has narrow dark bars. The lower fins dusky with a creamy white anterior edge bound behind by a narrow black streak. On the sides numerous pale brownish blotches encircle small vermilion spots.

The Brook or Speckled Trout of the east is indigenous to the region east of the Alleghany Mountains and the Great Lakes region, extending from North Carolina on the south to Labrador on the north. The distribution of this Trout has been wonderfully extended by artificial introduction, as it has always been a favorite with fish culturists. It is now to be found thriving in many of the Western States and Territories, and is particularly thrifty in Nebraska, Colorado, Nevada, and California. It has also been sent to Mexico and to European countries. The average Brook Trout seldom exceeds 7 or 8 inches in length, and smaller individuals are much

more abundant and require legal protection. In the northeastern part of its habitat the Brook Trout grows much larger, specimens weighing from 3 to 6 pounds being not uncommon; and in one of the Rangeley lakes an individual weighing 11 pounds is recorded, while Seth Green took a 12-pound specimen in the Sault St. Mary, and Hallock mentions one which was said to weigh 17 pounds.

The Brook Trout does not flourish in water warmer than 68° and prefers a temperature of about 50°. It is an inhabitant of the cold, clear mountain streams, and will leave a region which becomes polluted by mill refuse and other hurtful substances. In the Long Island region and around Cape Cod, where the Brook Trout has free access to salt water, it has the habit of going to sea in the fall and remaining during the winter. It then grows rapidly and becomes a much more beautiful fish than many which live exclusively in fresh water. In hot weather, when the temperature of the streams becomes too high and lakes are accessible, trout seek the deep parts of the lakes and the vicinity of cold springs. In streams they are to be found in deep pools or in channels. They feed in spring and early summer among the rapids on insects and small crustaceans.

The Brook Trout is a nest-builder. Cavities are made in the gravel, and the nest is shaped with the tail, and the larger stones are carried in the mouths of the parents. After the eggs are deposited they are covered with gravel. The eggs are not all deposited at one time. Spawning usually begins in October, but Brook Trout are spawning at some locality in almost every month of the year except mid-summer. The egg is about one-fifth of an inch in diameter, and varies in color from pale lemon to orange red. The average yield of the female is from 400 to 600. Livingston Stone has taken 1,800 from a fish weighing 1 pound.

The period of hatching will depend on the temperature, ranging from 165 days in water of 37° to 32 days in water of 54°. The yolk sack is absorbed in from 30 to 80 days, and after its absorption the young fish begin to feed. The rate of growth will of course depend on the amount of food consumed. In artificial culture yearlings, according to Mr. Ainsworth's estimate, will average 2 ounces; fishes of two years 4 ounces; of three years, 8 ounces, and of 4 years, 1 pound.

The value of the Brook Trout as a food fish and its game qualities are so well known that I need hardly refer to them here.

The Brook Trout is well adapted to domestication in aquarium tanks; it soon overcomes its fear of moving objects, takes its food regularly, and is always attractive because of its beauty and graceful movements. It will live in fresh and salt water. When it is attacked by fungus in fresh water, the parasite is easily killed by introducing salt water, gradually increasing in salinity, and the trout is not at all

injured or inconvenienced by the treatment. In captivity the food consists almost entirely of chopped hard clams and liver for the young, while hard clams, live killifish and occasional earthworms are given to the large fish. The increase in size with such feeding is remarkable. A Brook Trout from Caledonia, N. Y., not more than $3\frac{1}{2}$ inches long in November, 1896, measured $12\frac{1}{4}$ inches in length and $3\frac{1}{2}$ inches in depth December 10, 1897.

A single young Brook Trout from Caledonia survived in water of 76° F., but that temperature was generally fatal to the species.

Dr. Meek has found the trout in small streams on the uplands throughout the Cayuga Lake basin.

Mitchill knew this fish chiefly as an inhabitant of Long Island waters, and has given an interesting account of the fishing at Nichols', Patchogue and Fireplace, where a Mr. Robbins in 12 days in the summer of 1814 caught 190 trout weighing 139 pounds 11 ounces. The largest at Patchogue weighed $2\frac{1}{2}$ pounds, the largest at Fireplace, 3 pounds. A Mr. Purvis of New York caught a trout measuring 24 inches and weighing $4\frac{1}{2}$ pounds at Fireplace.

At that time, according to Mitchill, the trout was "bought at the extravagant price of a quarter of a dollar for a single fish not more than 10 or 12 inches long," and New York anglers traveled "away to Hempstead and Islip for the pleasure of catching and eating him."

69. Saibling (*Salvelinus alpinus* Linnæus). (Introduced.)

Salmo alpinus LINNÆUS, Syst. Nat., ed. X, I, 309, 1758, Lapland, West Gothland.

Salvelinus alpinus BEAN, Proc. U. S. Nat. Mus., Sterling Lake, New York and New Jersey; JORDAN & EVERMANN, Check-List Fish. N. A., 293, 1896; and Bull. 47, U. S. Nat. Mus., I, 508, 1896.

Body moderately elongate, compressed, its greatest depth two-ninths of total length to caudal base; the caudal peduncle short and stout, its least depth two-fifths of length of head; head rather short, its length contained from four and one-third to four and one-half times in total length to base of caudal (middle caudal rays). The body is somewhat elevated at the nape and for a short distance behind it. Mouth large, the maxilla reaching somewhat behind eye, its greatest width less than one-fourth of its length, the upper jaw one-half as long as the head; eye rather large, nearly equal to snout, one-fifth of length of head; interorbital space convex, one and one-half times diameter of eye; lower jaw very slightly projecting; vomerine teeth in a very small patch on the head of the bone, lingual teeth strong, teeth on both jaws well developed, those of the mandible strongest; gill rakers short,

straight, very slender, the longest one half as long as the eye, 11 above and 14 below the angle of the first arch. The dorsal origin is nearer to tip of snout than to base of caudal, its distance from the snout equaling twice the length of head; the dorsal base is as long as the postorbital part of head; the longest dorsal ray is two-thirds as long as the head, and nearly twice as long as the last ray. Adipose fin twice as long as wide, as long as the iris, its origin distant from base of middle caudal rays a space equal to length of head without the snout; the fin is over the end of anal base. Ventral midway between tip of snout and base of middle caudal rays, its length two-thirds of length of head; its appendage as long as the eye. Anal fin distant from ventral origin a space equal to length of head; anal base as long as snout and eye combined; longest anal ray equal to ventral and nearly two and one-half times last anal ray. Pectoral as long as the head without the snout. Caudal well forked, its outer rays about as long as the pectoral fin.

Color of the upper parts dark gray or greenish, the sides with a silvery shade passing into a deep red or orange on the lower half and, especially, the belly; red spots on the sides; lower fins margined with white and a blackish shade within the margin; sides of the head silvery; dorsal and caudal fins uniform dusky, unspotted.

The Saibling has been introduced into the United States, and a specimen was obtained from Sterling Lake, N. J., December 29, 1888. This was presented by A. S. Hewitt, Jr., to Eugene G. Blackford of New York City, and by him forwarded to the U. S. National Museum for identification and preservation. The specimen is $9\frac{3}{5}$ inches long. It does not differ in any way from European specimens with which it has been compared, as may be seen from the following description:

The greatest height of the body equals two-ninths of the total length without caudal; the least height of the caudal peduncle is two-fifths of greatest depth of body and one-third of length of head. Head large, one-fourth of total length without caudal; snout equal to eye, four in head; maxilla extending to slightly behind orbit, its width nearly one-fourth of its length; mandible slightly projecting. Dorsal origin nearer to tip of snout than to base of caudal; base of dorsal one-half as long as the head; longest dorsal ray equal to pectoral and nearly two-thirds of length of head; last dorsal ray one-third of length of head. Adipose fin over the last two or three anal rays, its length about equal to diameter of iris. The ventral origin is under the fifth or sixth divided ray of the dorsal; the fin is as long as the postorbital part of the head; its appendage is not quite one-third as long as the fin, and equals the diameter of the iris. The anal base is four-ninths as long as the head; the last ray of the fin is one-half as long as the longest, which is one-half as long as the head. The pectoral reaches almost to below the origin of

the dorsal, its length two-thirds of length of head. Caudal deeply forked, its middle rays less than one-half as long as the outer, which are equal to length of head without the snout.

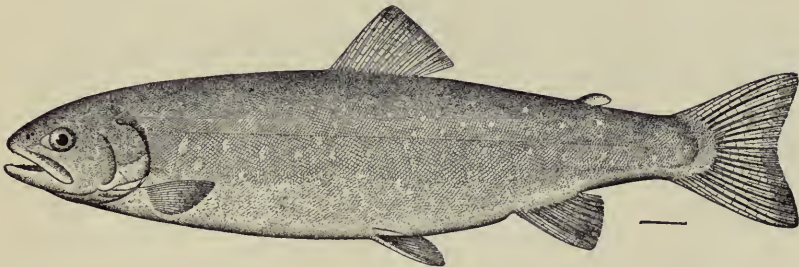
The fish is an immature male with about 10 oblong parr marks on the sides and with a few narrow dark blotches simulating half bands on the back from near the nape to a point behind the dorsal fin; numerous pale spots along the middle of the sides, each of which no doubt had a vermilion spot in the center in life.

Sterling Lake is in New York and New Jersey; and it was stated that the trout are found in streams emptying into the lake. This is noteworthy as being the only instance, as far as known, of successful introduction of the Saibling into our waters.

70. Sunapee Trout; Golden Trout; Silver Trout (*Salvelinus aureolus* Bean).
(Introduced.)

Salvelinus aureolus BEAN, Proc. U. S. Nat. Mus., 628, 1887, Sunapee Lake, New Hampshire.

Salvelinus alpinus aureolus JORDAN, Forest and Stream, Jan. 22, 1891; QUACKENBOS, Trans. N. Y. Ac. Sci., XII, 139, 1893; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 511, 1896, pl. LXXXIII, fig. 220, 1900.



SUNAPEE TROUT.

The type of the description, No. 39,334, was obtained in Sunapee Lake, N. H., in the fall of 1887 by Dr. John D. Quackenbos.

The length of the specimen to the caudal base is $6\frac{2}{5}$ inches; the greatest height of the body equals the length of the head, and is contained about four times in the total without caudal; the least height of the tail equals one-third the length of the head. The maxilla reaches past the middle, but not to the end of the eye; its length is contained about two and two-thirds times in length of head. The length of the upper jaw is contained about two and one-third times in the length of the head, and is equal to the longest anal ray; the eye is a little longer than the snout, and is contained four and two-sevenths times in the length of the head; hyoid teeth well developed; the first dorsal is a little nearer the tip of snout

than to the base of caudal, and the length of its base is one-half the length of the head; the adipose dorsal is distant from end of first dorsal a space equal to twice the length of the ventral; the anal is at a distance from the snout equal to about three times the length of the head; the longest anal ray is equal to the length of the upper jaw; the length of the middle caudal rays is equal to twice the diameter of the eye. The ventral is situated midway between the tip of the snout and caudal base; its length equals one-half the length of the head. The length of the pectoral is about twice the width of the interorbital area. B. 10; D. iv, 9; A. iii, 8; P. 13; V. 9. Scales, 35-210-40; gill rakers, 6+10-12. The peculiarity of the gill rakers of this trout is that they are always curled up at the ends and not straight, as in the *oguassa* from Maine.

Colors. Sides silvery white. Back with about six well-defined band-like markings, besides some irregular dark blotches. There are about 10 parr marks on the sides and numerous small, roundish, white spots. In colors this char is different from the *oguassa* from Maine, but, if fresh specimens of the Maine trout were compared with this young fish, the difference in color might not be so great.

The specimen described is a young male with the spermaries showing as a mere slight ribbon. Its stomach contained an earthworm and the wing cases of a squash beetle. The other two specimens (somewhat smaller) are females far from maturity.

In a female, 11 inches in total length, both parr marks and bands across the back show very plainly. This female has a few free eggs in the abdominal cavity and seems to be nearly spent. In examples of this size the tail is deeply forked, the middle rays being less than one-half as long as the external rays.

In males the pectoral is always longer than in females of equal size.

The following color notes were taken from Nos. 38,321 to 38,328, collected by Col. Hodge in Sunapee Lake, December 10, 1886. Head and upper parts brownish gray, caudal the same, with the exception of a narrow white margin on the lower lobe; under surface of head, in most examples, brownish gray, in others whitish; belly orange, this color extending up on the sides but not to the middle line of the body; anal orange, with white margin in front; ventrals orange, with broad white margin on the outer rays; pectorals, gray upper half and orange lower half; dorsal gray, lighter along the base; sides, both above and below lateral line, with numerous orange spots, fading out to whitish. The largest of these spots are little more than one-third as long as the iris. No mottlings anywhere.

The Golden Trout is a native of Sunapee Lake and Dan Hole Pond, in New Hampshire, and of Flood's Pond, in Maine. Doubtless it exists in other lakes of New England and British North America.

It is a large species, reaching a length of 20 inches and the weight of 6 or 8 pounds; even larger individuals have been reported. Spawning takes place in Sunapee Lake on reefs in shallow water, and not in the streams tributary to the lake; the season is about the same as for the Brook Trout. The colors of the male in the breeding season are gorgeous, and the sight of a host of spawning fish in the water is one to be remembered.

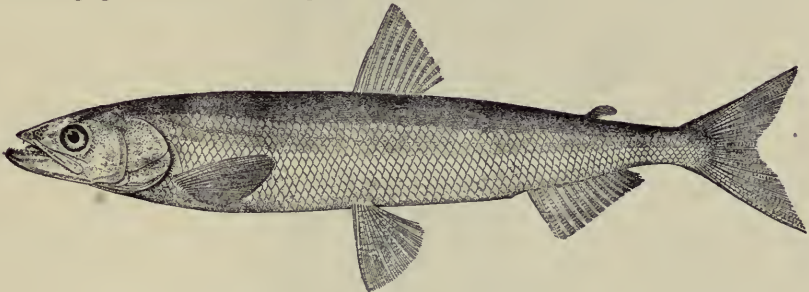
Many large and small trout of this kind have been deposited in Lake George and other suitable waters of the State.

71. Smelt; Ice Fish (*Osmerus mordax* Mitchill).

Atherina mordax MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 446, 1815, New York.

Osmerus viridescens DEKAY, N. Y. Fauna, Fishes, 243, pl. 39, fig. 124, streams flowing into Long Island Sound, Hackensack and Passaic Rivers.

Osmerus mordax BEAN, Fishes Penna., 64, pl. 26, fig. 46, 1893; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 523, 1896, pl. LXXXVI, fig. 228, 1900; EVERMANN & KENDALL, Rept. U. S. Commr. Fish & Fisheries for 1894, 593, 1896, Lake Memphremagog and Lake Champlain.



SMELT.

The Smelt is known along our east coast from Labrador to Virginia. It probably extends still farther north, but the record of W. A. Stearns, published in the Proceedings of the National Museum for 1883, p. 124, fixes the most northern locality known at present. He found the Smelt common in August in shoal water off the wharves of Cape Breton. In Pennsylvania the fish is common in the spring in the Delaware and Schuylkill Rivers. In numerous lakes of Maine, New Hampshire, and other New England States, the Smelt is common landlocked, and thrives as well as in the salt water.

DeKay knew the Smelt as a marine species ascending the Hackensack and Passaic Rivers. The species occurs also in Lakes Champlain and Memphremagog. In the former lake it reaches a large size. At Port Henry, N. Y., the fish is called Ice Fish.

The upper parts are greenish; a broad silvery band along the sides; body and fins with numerous minute dusky points.

The Smelt grows to a length of 1 foot; the average size as found in the markets is about 7 inches. It enters the rivers for the purpose of spawning and is most abundant in the winter and early spring months. Spawning takes place in the Raritan River, N. J., in March. The eggs of the Smelt have been artificially hatched by Mr. Ricardo, Fred Mather and other fish culturists.

The Smelt begins to run into Gravesend Bay in December and remains during cold weather. In the spring it ascends rivers to spawn. The eggs are small ($\frac{1}{16}$ inch in diameter) and number 496,000 to the fluid quart; they adhere to stones, twigs, etc., on the bottom. Some females begin to spawn when only 3 or 4 inches long.

Its range has been widely extended by artificial introduction, which is very easily effected by transporting the fertilized eggs from the small brooks in which the species spawns.

In fish cultural operations "the spawning fish, of both sexes, are placed in troughs, which are covered to exclude light, which is very injurious to the eggs. The eggs are naturally laid and fertilized, and become attached to each other and to the troughs. They are scooped up with a flat shovel, placed on wire trays in water, and are forced through the meshes of the trays to separate them. They are hatched in automatic shad jars, blanketed to exclude light. If during hatching the eggs bunch, they are removed from the jars and again passed through the meshes of the wire trays."

The Smelt is an excellent food fish and is also used for bait, and still more extensively as food for Landlocked Salmon, Lake and Brook Trout and other important salmonoids, which are artificially reared in lakes. It has proved to be one of the best fishes for this purpose. Immense quantities of Smelts are caught during the winter months in nets, seines and by hook and line. They are usually shipped to market in the frozen condition, packed in snow or crushed ice. The fish which have not been frozen, however, are prized more highly than any others.

The fry are hardy in transportation.

In captivity the adults live till about the end of June, when the water becomes too warm and they die. Their food consists mainly of shrimps and other small crustaceans.



BANDED PICKEREL (LUCIUS AMERICANUS).

72. Banded Pickerel (*Lucius americanus* Gmelin).

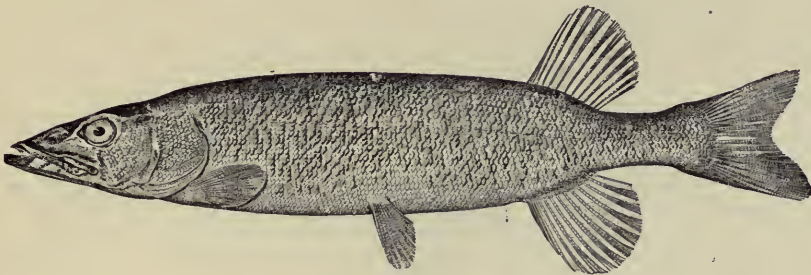
Esox scomberius MITCHILL, Amer. Month. Mag., II, 322, March, 1818, Murderer's Creek, New York.

Esox fasciatus DEKAY, N. Y. Fauna, Fishes, 224, pl. 34, fig. 110, 1842, streams and ponds of Long Island.

Esox americanus BEAN, Fishes Penna., 89, pl. 28, fig. 53, 1893.

The Banded Pickerel is probably identical with the "Mackerel Pike" of Mitchill. It is a small fish, seldom exceeding 12 inches in length, and will not average more than $\frac{1}{2}$ pound in weight. It occurs only east of the Alleghanies, from Massachusetts to Florida in coastwise streams. In Pennsylvania it is limited to waters in the eastern part of the State, and the same is true in New York.

This Pickerel is too small to have much importance as a food fish. It resembles in general appearance and habits the Little Pickerel of the west. It frequents clear,



BANDED PICKEREL.

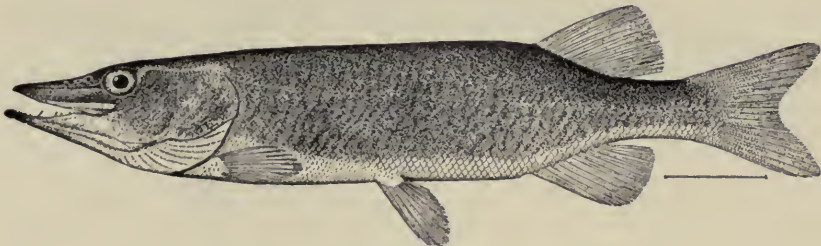
cold and rapid brooks and is said to associate with the Brook Trout without injury to the latter.

December 30, 1895, James Annin, Jr., sent from Rockland, N. Y., a small Pickerel which had attracted his attention on account of its colors and markings. It was taken in a small spring brook, tributary to the Beaverkill, which, about 10 or 15 miles below, unites with the Delaware. Subsequently two examples were forwarded alive from the same place. The following notes and measurements, in inches, relate to the first individual of undetermined sex, the organs being undeveloped.

MEASUREMENTS.

	INCHES.
Length, including caudal fin, - - - - -	7 $\frac{3}{4}$
External caudal lobe (horizontally), - - - - -	1 $\frac{1}{8}$
Middle caudal rays (from end of scales), - - - - -	$\frac{1}{2}$
Length of head, - - - - -	1 $\frac{3}{4}$
Greatest depth of body, - - - - -	1 $\frac{1}{8}$

	INCHES.
Least depth of caudal peduncle, - - - - -	$\frac{1}{2}$
Length of snout, - - - - -	$\frac{5}{8}$
Length of maxilla, - - - - -	$\frac{11}{16}$
Length of mandible, - - - - -	$1\frac{3}{16}$
Diameter of eye, - - - - -	$\frac{5}{16}$
Distance from snout to dorsal, - - - - -	$5\frac{3}{16}$
Length of dorsal base, - - - - -	$\frac{7}{8}$
Length of longest dorsal ray, - - - - -	$\frac{3}{4}$
From end of dorsal to caudal origin, - - - - -	$\frac{7}{8}$
Distance from snout to pectoral, - - - - -	$1\frac{5}{8}$
Length of pectoral, - - - - -	$\frac{3}{16}$
Distance from snout to ventral, - - - - -	$3\frac{5}{8}$
Length of ventral, - - - - -	$\frac{3}{4}$
Distance from snout to anal, - - - - -	$5\frac{1}{4}$
Length of anal base, - - - - -	$\frac{3}{4}$
Length of longest anal ray, - - - - -	$1\frac{11}{16}$
From end of anal base to origin of lower caudal lobe, - - - - -	$\frac{3}{4}$



LITTLE PICKEREL.

B. 12; D. 12; A. 11; V. 9. Scales, 24-110. The maxilla reaches to below the middle of the pupil. The mandible projects $\frac{1}{16}$ of an inch when the mouth is closed. The diameter of the eye is contained five and two-thirds times in length of head. The stomach was empty, but insect remains were voided from the vent.

73. Little Pickerel (*Lucius vermiculatus* LeSueur).

Esox vermiculatus BEAN, Fishes Penna., 90, pl. 28, fig. 54, 1893.
Lucius vermiculatus JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 627, 1896.

This Pickerel inhabits the valleys of the Ohio and Mississippi Rivers and streams flowing into the Great Lakes from the southward. In ponds formed in the spring by the overflow of river banks it is one of the characteristic fishes and is often destroyed in great numbers by the drying up of such bodies of water. In Pennsyl-

vania the Little Pickerel, or Trout Pickerel, is common in the Ohio and its tributaries. Prof. Cope mentions it also as an inhabitant of the Susquehanna River, in which it is probably not a native.

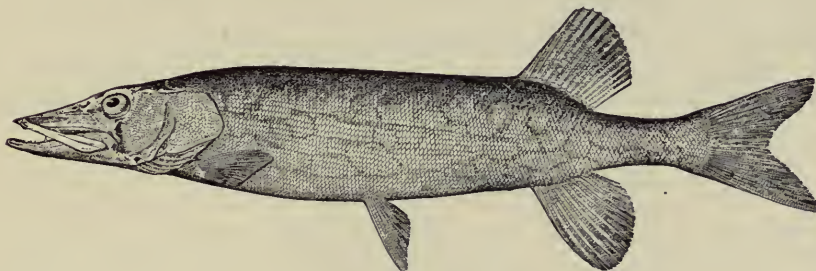
The U. S. Fish Commission obtained a moderate number of specimens in the Lake Ontario region at the following New York localities: Black Creek, tributary of Oswego River, Scriba Corner, July 15; Lakeview Hotel, 7 miles west of Oswego, July 17; Wart Creek, July 24; Great Sodus Bay, August 16; Outlet Long Pond, 4 miles west of Charlotte, August 7; Marsh Creek, near Point Breeze, August 21. This fish grows to the length of 1 foot and is, therefore, too small to have much importance for food.

74. Chain Pickerel; Green Pike (*Lucius reticulatus* LeSueur).

Esox reticulatus JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 353, 1883.

Esox reticulatus BEAN, Fishes Penna., 90, pl. 29, fig. 55, 1893.

Esox tridecemlineatus MITCHILL, Mirror, 361, 1825, Oneida, N. Y.



CHAIN PICKEREL.

The Chain Pickerel is known under other names; it is the Jack of the south, the Federation Pike of Oneida Lake, N. Y., the Green Pike of the Great Lakes and the Eastern Pickerel of many writers. It does not occur west of the Alleghanies, but is found from Maine to Florida and Alabama east of this range of mountains. It lives in ponds, lakes and streams and occurs within the same territory as *L. americanus*, but farther away from the coast. (After Eugene Smith, Proc. Linn. Soc. N. Y., No. 9, p. 29, 1897.)

At Water Mill this Pickerel occurs in or near brackish water at the east end of Mecox Bay, and it is in very plump condition on account of the abundance of small fishes on which it feeds, for example, the Silversides, young Sunfish, and small Killifishes of several kinds.

Dr. Meek notes that the species seems to be subject to individual variation. In many respects the specimens from Cayuga Lake appear to be intermediate between *reticulatus* and *vermiculatus*. It is not very common.

The Pickerel is common in ponds and streams of the Hudson Highlands, accord-

ing to Dr. Mearns, and is taken in winter as well as summer. A specimen weighing $3\frac{1}{2}$ pounds was caught in Poplopen's Pond in 1882. It is abundant also in Kaaterskill Lake, of the Catskill Mountains. The U. S. Fish Commission obtained it in Black River, Huntingtonville, N. Y., July 5. Examples were sent from Canandaigua Lake, and young were obtained in Bronx River.

The Pickerel is the largest of its group, reaching a length of 2 feet and a weight, occasionally, of 8 pounds, though this is much above the average.

Like the Pike, this is one of the tyrants among fishes, a fierce and hungry marauder; and yet it has been introduced by fishermen into many waters in which it is not native and has greatly multiplied. In the Potomac, the Connecticut, the Delaware and other large rivers the Pickerel abounds; it is to be found in large numbers lying in wait among the river grasses or in ponds under the shelter of leafy water plants for the minnows which it consumes in enormous numbers, or some unlucky insect, frog or snake which attracts its voracious appetite.

Spawning takes place in the winter and early in the spring, and the young soon become solitary and wolfish like their elders.

The fish obtained from Canandaigua Lake spawned in their tank in June, 1897, and the young were naturally hatched, but they died when about three-fourths of an inch long for want of acceptable food.

As a food fish not much can be said in praise of the Chain Pickerel, though it is eaten and doubtless liked by a good many people. The flesh is often coarse and watery and it is always full of small bones. This fish, however, furnishes considerable sport to the angler, since it is a very free biter and fights with great boldness and stubbornness when hooked. It is caught by trolling with a spoon or still fishing with live shiners, pickerel frogs and many other baits. A minnow gang is often very effective in Pickerel fishing. The hooks must be tied on gimp as a protection for the line from the sharp teeth of the fish.

This species is always hard to keep in good condition in captivity, because of its liability to fungus attacks. The salt water treatment, however, keeps the fungus in check.

75. Common Pike (*Lucius lucius* Linnæus).

Esox lucius JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 353, 1883.

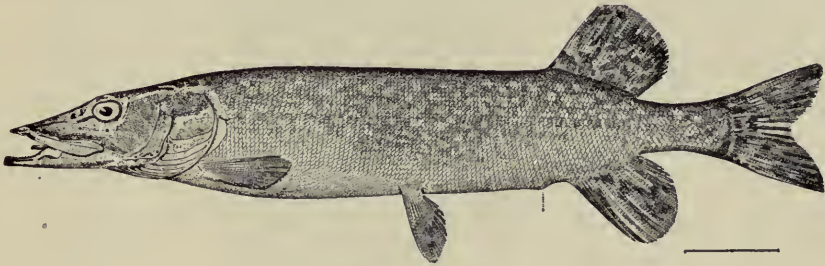
Esox lucius BEAN, Fishes Penna., 91, pl. 29, fig. 56, 1893.

Esox estor DEKAY, N. Y. Fauna, Fishes, 222, 1842.

The ground color of the body is grayish varying to bluish or greenish gray. The sides are thickly covered with pale blotches, none of them as large as the eye,

arranged nearly in rows. The dorsal, anal and caudal fins have many rounded, dark spots. Adults without dark bar below eye. Naked part of opercle bounded by a whitish streak. In the young the sides are covered with oblique yellowish bars, which afterward break up into the pale spots of the adult.

Pike is the best known name for this species, though the misnomer "Pickerel" is rather extensively used. The origin of Pike is involved in uncertainty; some trace it to the resemblance in shape of the snout to the pike or spear, while others believe it to refer to the darting motion of the fish when speeding through the water. The name Pickerel is used in Vermont and around Lake George, N. Y. "Frank Forrester" (Herbert) styles it the Great Northern Pickerel. The name Jack is applied in Great Britain to young Pike. *Brochet* is the French name, *Hecht* the German and *Luccio* the Italian designation of the species. In Prof. Cope's paper in earlier reports of the Pennsylvania Fish Commission the names Lake Pike and Grass Pike are used for the fish.



COMMON PIKE.

Distribution. In the north temperate and arctic regions of North America, Europe and Asia the Pike is equally common. In North America it extends from Pennsylvania to high northern latitudes. In Alaska Townsend and others found it in abundance in the Yukon. From Greenland and the islands of the Arctic Ocean the Pike appears to be absent. The identity of our American Pike with the common one of Europe was recognized by Cuvier and Richardson more than half a century ago; the former compared specimens from Lake Huron with European examples, and Richardson with the English Pike, and both were unable to find specific differences between the two.

The Pike is said to be common in Lake Champlain and in all its larger tributaries. In the Lake Ontario region the U. S. Fish Commission collectors secured it at the following places: Mud Creek, Cape Vincent, N. Y., June 25, 1894, Chaumont River, July 10, outlet Long Pond, 4 miles west of Charlotte, N. Y., August 17.

Dr. Meek found the species in Cayuga Lake, where, he says, he was unable to find any other fish of the genus except the Pickerel. James Annin, Jr., obtained

the Pike in Silver Lake, Wyoming County, N. Y., July 1, 1896. He reports that it does not occur in Canandaigua Lake.

On the continent of Europe the largest recorded specimen was taken at Bregenty in 1862; this was said to weigh 145 pounds. In Scotland a Pike measuring more than 7 feet and weighing 72 pounds has been reported. We do not find monsters like these in America. "Frank Forrester" mentions individuals of 16 to 17 pounds. Lake George, N. Y., is famous for its large Pike. Dr. Frank Presbrey of Washington, D. C., caught one there in 1889 weighing a little more than 16 pounds, and more than 30 examples averaging in excess of 10 pounds each were taken that season by another Washington party in the same waters. Some of the largest Pike were upward of 4 feet long. The average length of adults is about 2 feet.

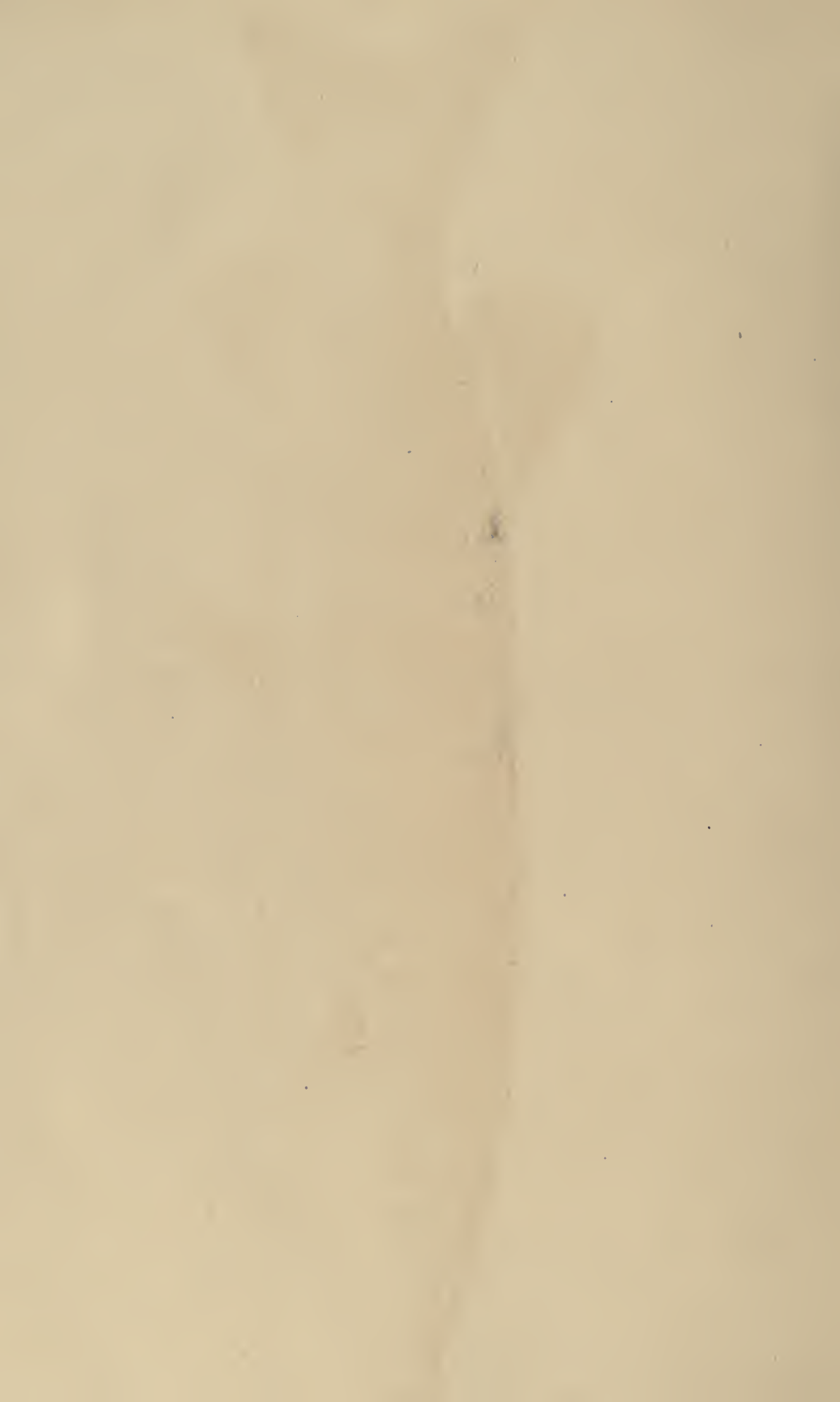
The fishing season generally begins June 1 and ends December 1, but many of the States have no close season. In Pennsylvania the close time lasts from December 1 to June 1.

The Pike is a voracious fish and destroys everything within its reach in the form of animal life; other fish, water birds and mammals are consumed in enormous numbers. From its concealment, like a beast of prey, it darts out suddenly on its victims and seldom misses its mark. The Pike is even more destructive than the Pickerel, and two of the latter, measuring 5 inches in length, have been reported to eat more than 100 minnows in a day. Spawning takes place in winter and early spring on shallows and frequently on overflowed meadows. The eggs are about one-eighth inch in diameter, and a female weighing 32 pounds was estimated by Buckland to contain 595,000. The young Pike has a very large yolk sac. The period of hatching varies, with the temperature of the water, from 14 to 30 days. The female is said to be larger than the male; the fish breeds at the age of three years. At the age of one year the fish may reach a length of 12 inches, and if well supplied with food it will increase in weight from 2 to 3 pounds yearly.

The Pike is a fairly good food fish and forms an important element of the Lake Erie fisheries. As a game fish the species is widely known; it can be readily caught by trolling or spinning or on lines set under the ice. Live minnows and frogs are favorite baits; and Dr. Henshall says it will rise to a large, gaudy fly. In Lake George the White Chub is one of the best known baits.



MASCALONGE { LUCIUS MASQUINONGY }.



76. Mascalonge; Spotted Mascalonge (*Lucius masquinongy* Mitchill).

Esox masquinongy MITCHILL, Mirror, 297, 1824, Lake Erie.

Esox nobilior BEAN, Fishes Penna., 93, pl. 29, fig. 57, 1893.

Lucius masquinongy JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 629, 1896, pl. C., fig. 270, 1900.

The color is usually dark gray, sometimes immaculate as in the color variety *immaculatus*, but generally with numerous distinct, roundish, black spots about as large as buckshot. The dark spots are present only on the basal parts of the dorsal, anal and caudal fins. The lower parts are pale, the belly white.

The name of this giant Pike is apparently derived from the language of the Ojibwa or the Cree Indians; it is variously spelled and its meaning is uncertain, though the roots, according to H. W. Henshaw, are probably *mask* (ugly) and *kinongē* (fish). In the books it appears as Muscalonge, Muskellunge, Muskallunge



MASCALONGE.

Mascalonge and Maskinonge, all variations of the same term. Some writers style it the Great Pike, and by others it is confused with the common Pike, *E. lucius*. Prof. Cope mentions also the name Blue Pike.

The Mascalonge is recorded by Prof. Cope from Conneaut Lake, Crawford County, Pa., the specimen measuring 17 inches in circumference behind the eyes. It is found occasionally in the Ohio Valley. The species, however, is most abundant in the Great Lakes region. In Lake Erie favorite localities are Dunkirk and Barcelona, N. Y., Erie, Pa., and Mills' Grove, O. The northern limit of the fish is not definitely fixed.

It is asserted by some persons that the fish inhabits Cayuga Lake, but others deny this. Dr. Meek was unable to find it there after diligent search. It was known in Lake Champlain more than half a century ago and was described by Rev. Zadock Thompson. Mitchill and Kirtland had it from Lake Erie. DeKay confounded the Mascalonge with the Pike, and apparently had no example of the former. In the St. Lawrence River the species is well known.

It is recorded that in 1865 Mr. Schultz caught a Mascalonge at Milwaukee weighing 100 pounds. In 1864 Fred. Alvord declared that he had an 85-pound specimen in Maumee Bay. The average length of the species is about 3 feet, and there is reason to believe that a length of 8 feet is sometimes reached. Individuals weighing 50 pounds are moderately common. With the exception of the Lake Trout and some of the Salmon, this is undoubtedly the largest game fish in the United States.

The fish seem not to be gregarious, but occur usually in pairs. Their food consists mainly of smaller fishes, and their voracity is notorious. In the spawning season, in small rivers falling into Lake Simcoe, Richardson states that they feed on small fishes and on gelatinous green balls which grow on the sides of banks under the water.

This is an excellent food fish, but not common enough to have much commercial importance. As a game fish it has few superiors. The spoon bait is very effective in the capture of Mascalonge, and live fishes are extensively used. A correspondent of *Land and Water* describes a singular and successful lure made from a young brown calf's tail, through the center of which the shank of the hook was passed and fastened to a swivel.

77. Northern Mascalonge (*Lucius immaculatus* Garrard).

Body unspotted, or with vague, dark, cross shades; tail a little more slender and fins a little higher than in the Spotted or Lake Mascalonge.

Lakes and rivers of Wisconsin and Minnesota, locally abundant. This is probably not distinct from the Mascalonge of Chautauqua Lake.

78. Unspotted Mascalonge; Barred Mascalonge (*Lucius ohiensis* Kirtland).

Lucius lucius immaculatus BEAN, by error, Bull. Am. Mus. Nat. Hist., IX, 353, 1897.

Examples of Unspotted Mascalonge were received at the New York aquarium from Chautauqua Lake, N. Y., which belongs to the Ohio River drainage system. It appears that the typical spotted form also inhabits the Ohio basin, but occurs rarely. Mr. Annin sent one individual December 4, 1895, and two on May 4, 1896.

In all the specimens the maxilla extends to below the front edge of the pupil. The gill rakers are mere clumps of spiny tubercles. In the two males the diameter of the eye is contained from four and one-third to five times in the length of the snout, and from 10 to 11 times in the length of the head.

In the individual of December 4, 1895, the lateral line tubes are distributed over various parts of the sides without much regularity except in the median line. There are no black spots. About 20 entire, blotch-like, irregular cross bands and several parts of bands and blotches intervening. The lower third of the pectoral is pink. The dorsal, caudal and anal with dark blotches making pseudo bands. Iris lemon yellow overlying silvery white. The general color is olive green with golden tints.

The two males of May 4, 1896, furnished the following notes:

Olive green tinged with golden bronze; sides with about twenty irregular dusky blotches resembling interrupted bands; dorsal, caudal and anal with numerous large dusky blotches, those on dorsal and anal almost forming bands; iris lemon yellow and silvery in the larger, almost vermilion and orange in the smaller; a dark blotch at upper edge of opercle.

The Chautauqua Lake Mascalonge, according to James Annin, Jr., who sent the specimens, is a very fine food and game fish, and attains to the weight of 50 pounds. In the spring of 1895 it was not unusual to capture individuals weighing from 40 to 50 pounds, and 20 to 30 pounds was a very common weight. In winter the fish frequent nearly the same localities as in summer, being found in the vicinity of water plants. When the lake becomes very clear in February they go into deep water, but they live in deep water more or less all the year.

For the fish culture operations the nets are set as soon after the first of April as the ice leaves the lake. The fish begin to spawn a few days after and continue till the latter part of April. They go into shallower water for spawning; most of them spawn in from 10 to 15 feet of water. They do not resort to the gravel like many other fish, but to mud, generally going into bays. The eggs are placed in boxes, all of which are provided with screens at top and bottom. The bottom has an extra screen to prevent minnows from injuring the eggs. The boxes are sunk from 1 foot to 2 feet under the surface of the water. Every day or two they are drawn up, the covers removed, and all bad eggs and sediment cleaned out.

During the first experiments in Chautauqua Lake, N. Y., Monroe Green and Jonathan Mason obtained the eggs in April and May, 1890, and these were artificially hatched. A large female yielded 60,000 eggs. With the water at the temperature of 40° to 46° very few of the eggs were developed, but when it neared 60°, in May, better results were secured. On May 27 75,000 young fish were planted in the lake. The eggs were hatched in a box suspended about 4 feet from the bottom in 18 feet of water.

79. Silversides; Friar; Whitebait (*Menidia notata* Mitchill).

Atherina notata MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 446, 1815; DEKAY, N. Y. Fauna, Fishes, 141, pl. 28, fig. 88, 1842, New York.

Atherina viridescens MITCHILL, op. cit., 447, 1815, N. Y.

Chirostoma notatum GOODE & BEAN, Bull. Essex Inst., XI, 21, 1879.

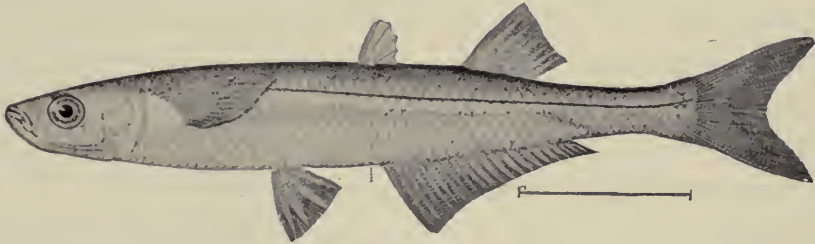
Atherina menidia DEKAY, op. cit., 142, pl. 74, fig. 236, 1842, N. Y., not of LINNÆUS.

Menidia notata BEAN, Bull. U. S. F. C., VII, 146, 1888; 19th Rept. Commrs. Fish. N. Y., 271, 1890.

Translucent green; lateral band silvery, mostly on the level of the eye, its width less than one-half the diameter of eye. Scales of upper parts with dark dots along their edges; chin speckled.

The Common Silversides grows to a length of 6 inches.

The Silversides was first made known by Dr. Mitchill under the name of Small Silverside, *Atherina notata*, and he described the young of the same species as the



SILVERSIDES.

Green-Sided Silverside, *Atherina viridescens*. Dr. DeKay states that the Silversides was known in the harbor of New York as the Anchovy and the Sand Smelt. Friar is a New England name for the species; Capelin is in use about Boston, and Merit fish in the vicinity of Watch Hill. Sperling is a name recently applied to this species by some fishermen, and we have known persons to offer the Silversides as Whitebait. In Great South Bay it is known as Shiner.

The Silversides is known to occur on the coast from Maine to Virginia. It is one of the most abundant of the small fishes in our waters, swimming in immense schools made up of fish of different sizes, and it forms a considerable part of the food of more valuable species, such as the Mackerel, Bluefish, Weakfish and Flounders, and is very much in demand as a bait for hook and line fishing. We seined the Silversides in all parts of Great South Bay, and found it to be one of the most abundant and characteristic species.

The Common Silversides, or Spearling, lives in Gravesend Bay almost all the year, hibernating in spring holes in winter. It is well suited for a captive life and can endure a temperature of $71\frac{1}{2}^{\circ}$ in the salt water.

In 1898 the species was found for the State Museum at all Long Island localities visited, Peconic Bay, Mecox Bay, the ocean at Southampton, and throughout Great South Bay. Small individuals are sold in the markets as Whitebait. In the time of DeKay the fish was called Anchovy and Sand Smelt and was esteemed a savory food. Twenty years before he wrote of the fishes of New York, it was caught from the wharves and sold for bait.

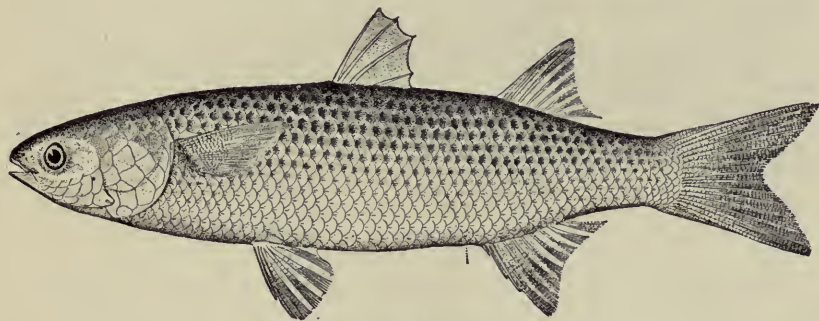
80. Striped Mullet (*Mugil cephalus* Linnæus).

Mugil cephalus BEAN, 52d Ann. Rept. N. Y. State Mus., 103, 1900.

Mugil albula BEAN, 19th Rept. Commrs. Fish. N. Y., 272, pl. XXI, fig. 26, 1890.

Mugil lineatus DEKAY, N. Y. Fauna, Fishes, 144, pl. 15, fig. 42, 1842, New York.

Color, darkish blue above; the sides silvery; exposed part of scales, especially of eight or ten upper series, darker than body color, causing a striped appearance



STRIPED MULLET.

belly and lower part of sides yellowish; ventral fins yellowish; soft dorsal, anal and ventrals dusky; tip and base of pectoral dusky.

The Striped Mullet grows to the length of 2 feet, but the average size in New York waters is much less.

The fish is known in Great South Bay as Mullet and Jumping Mullet; the name Mullet is applied to it also in the Gulf of Mexico, and is in general use along the east coast; it is known in the Chesapeake as Mullet or Fatback. The latter name is probably applied to more than one species.

The Striped Mullet is known on our coast from Cape Cod to the Gulf of Mexico. The young are much more abundant than the adults. In Great South Bay we found the species not uncommon; two examples were taken at the mouth of Swan Creek, September 12. Several schools were present. We were informed that they appear occasionally, and one gentleman of Patchogue was very successful in taking this and its allied species with hook and line. DeKay states that the Striped Mullet

was first observed in New York waters by Dr. Mitchill. He found them in the market in the beginning of September. This species is one of our choice food fishes. It is not uncommon in September in Great Egg Harbor Bay, N. J., but we are informed that large specimens are never taken in that body of water.

In 1898 the Striped Mullet was not abundant in the waters seined till fall; the great schools were absent till October. Several individuals were obtained in Mecox Bay, August 2, and a larger number in Clam Pond Cove, Great South Bay, August 22.

The young of this species are abundant in Gravesend Bay in midsummer; larger ones appear in September and October. One winter, some years ago, Mullet hibernated in the mud in Sheepshead Bay and were taken with eel spears. The Mulletts feed and thrive most of the year in captivity, but will not survive the intense heat of summer. In the aquarium their food includes hard clam and shrimp.

In 1883 Jordan & Gilbert established a genus *Querimana* for "little mullets with but two spines in the anal fin and with the teeth in the jaws less ciliiform than in *Mugil*; adipose eyelid wanting; preorbital serrate." The genus was based on *Myxus harengus* of Günther. *Querimana* is nothing more than the young of *Mugil*. The only good character by which it was distinguished is the presence of two anal spines instead of three; in all other respects *Querimana* and *Mugil* agree perfectly. As a matter of fact, all young *Mugils* pass through a *Querimana* stage in which only two of the three anal spines are developed, the adipose eyelid is rudimentary, and the teeth are comparatively stouter than in the adult. The third anal spine of *Mugil* is really a simple articulated ray till the fish reaches a length varying from about 40 mm. to 50 mm. The first simple ray of the anal becomes a spine by the breaking off at an articulation, the subsequent sharpening of the point, and the deposit of hard material in the articulations, thus forming a somewhat slender, but perfect spine.

This fact of development was carefully studied in large series of specimens in the U. S. National Museum, and it is both interesting and important from the fish cultural as well as the systematic standpoint. In *Mugil cephalus* one example, 41 mm. long, shows the third anal spine very plainly; it is well developed and has a sharp point, but several articulations still remain. Other examples of equal length have the first simple anal ray scarcely developed into a spine, and in still others this ray does not take on the character of a spine at all. *Querimana harengus*, the type of the genus, is the young of *Mugil curema*, and *Q. gyrans* is the immature *Mugil trichodon*. A re-examination of the types of *Querimana gyrans* shows the presence of 33 rows of scales in some examples instead of 29.

81. White Mullet (*Mugil curema* Cuv. & Val.).

Mugil curema BEAN, Bull. U. S. F. C., VII, 145, 1888; 19th Rept. Commrs. Fish. N. Y., 272, pl. XXI, fig. 26, 1890.

Mugil curema BEAN, 52d Ann. Rept. N. Y. State Mus., 103, 1900.

Mugil petrosus DEKAY, N. Y. Fauna, Fishes, 147, 1842.

Color silvery, bluish above; no dusky streaks along the sides in life, but faint streaks are evident after preservation in spirits; a small dark blotch at base of pectoral; caudal pale, yellowish at base, dusky at tip; anal and ventrals yellowish; two yellow blotches on side of head.

The White Mullet reaches the length of 1 foot. On the Atlantic coast it ranges from Cape Cod to Brazil; in the Pacific it is recorded from California to Chili. It is a very important food fish.



WHITE MULLET.

The White Mullet appears with the striped species, but is less abundant in Gravesend Bay and is smaller in size. The young were taken in Great South Bay in August, 1898, and half-grown individuals were abundant in September and October. Adults were scarce.

Dr. Mitchill calls this the Summer Mullet. He records a specimen that weighed $2\frac{1}{2}$ pounds, the heaviest coming under his observation. DeKay found the species in New York markets in July and August.

82. Common Mackerel (*Scomber scombrus* Linnæus).

Scomber scombrus JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 424, 1883.

Scomber scombrus JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 865, 1896, pl. CXXXIII, fig. 363, 1900.

Color dark blue, or greenish blue above, the upper parts with 30 or more wavy transverse bands of a darker hue, these extending below the lateral line and nearly to the median line of the body; beneath the ends of these lines and slightly sepa-

rated from them is a narrow, longitudinal, dark streak running almost the entire distance from the pectoral to the caudal; top of the head very dark; a dark blotch in the axil of the pectoral; gill covers and jaws silvery; sides white with cupreous reflections; belly white.

The Mackerel is one of the best known food fishes of the North Atlantic, ranging from Norway to Spain in Europe and from Labrador to Cape Hatteras in North America. It reaches the length of 18 inches. The fish is migratory and frequently disappears for a short or long period of time from its accustomed localities. On the New York coast the Mackerel appears in May and June in great schools, but the number varies greatly in different years.

Two young, $3\frac{1}{4}$ to $5\frac{1}{2}$ inches long, were taken in Gravesend Bay, L. I., May 23, 1896, in John B. DeNyse's shad fyke. No more were seen, and these were the first of the year. They come about the time of the appearance of Anchovy and Weak-



COMMON MACKEREL.

fish. They are often seen swimming at the surface of the bay in small bunches of 18 or 20, occasionally 100, in the latter part of May or early in June. They are always split up into small bunches, probably by the attacks of Weakfish and other predaceous species which are present at the time. Flukes attack them also in shallow water.

83. Chub Mackerel; Thimble-Eye Mackerel (*Scomber colias* Gmelin).

Scomber colias DEKAY, N. Y. Fauna, Fishes, 104, pl. 11, fig. 33, 1842.

Scomber colias JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 866, 1896, pl. CXXXIII, fig. 364, 1900.

Scomber colias BEAN, Bull. Am. Mus. Nat. Hist., IX, 360, 1897.

Colors essentially the same as in *Scomber scombrus*, the wavy transverse bands about 30 in number; sides mottled with small dusky blotches below the median line; about 20 black specks on base of preopercle, usually arranged in more than one series; belly and sides silvery; a black blotch in axil of pectoral.

The Chub Mackerel is found in the Atlantic and Pacific Oceans, north to England and Maine and to San Francisco; very common in the Mediterranean and in Southern California; sometimes abundant on our eastern coast and frequently absent for long periods. It reaches the length of 14 inches, and is an important food fish.

July 25, 1887, the schooner Peter Cooper caught 6,000 Thimble-eye Mackerel off Manasquan, N. J. About 50,000 Mackerel were taken by the Menhaden steamer A. Morris near Ocean City, July 19, 1887. Some of these were preserved in brine by W. B. Steelman, and I found them to be *S. colias*.

The Thimble-eyes usually arrive in August. In 1886 they were often caught. This species was not found in large numbers in Gravesend Bay in 1897, but in 1896 it abounded in all the little creeks, and in some instances the fish could be dipped up by boat loads with scoop nets. The fish reached 10 inches in length before the end of the summer.



CHUB MACKEREL.

84. Tunny; Horse Mackerel (*Thunnus thynnus* Linnæus).

Thynnus vulgaris DEKAY, N. Y. Fauna, Fishes, 105, pl. 10, fig. 28, 1842, after STORER.

Orcynus thynnus JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 429, 1883.

Thunnus thynnus JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 870, 1896.

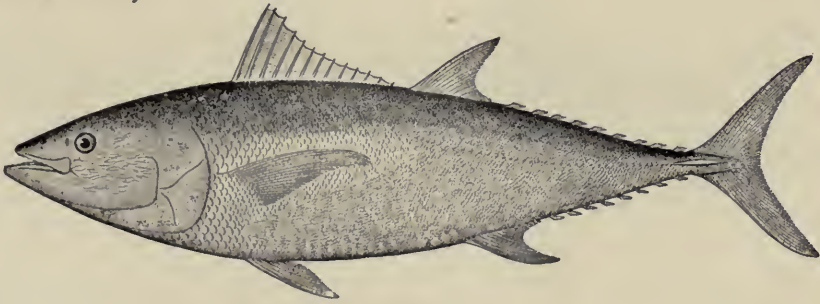
Color dark blue above; grayish below with silvery spots; pupil black, iris golden with greenish reflections; rays of spinous dorsal dusky, the connecting membrane nearly black, second dorsal reddish brown; pectorals silver gray; ventrals black above, white beneath; dorsal and anal finlets bright yellow, dark at base and on anterior edge; gill covers silvery gray.

The Tunny is the largest fish of the Mackerel family, reaching a length of 10 feet or more. It is pelagic, but comes to all warm coasts, northward to England, Newfoundland, San Francisco, and Japan. In our waters it appears usually in summer and is often taken in rather large numbers off Block Island, and on Cape

Cod and Cape Ann. On account of its enormous size and great strength, it is often destructive to the fishermen's nets.

Dr. Storer says it comes into Massachusetts Bay about the middle of June and remains till early in October. It was not uncommon to observe 50 or more in a day at Provincetown. It feeds on Menhaden, Mackerel, Whiting, Dogfish and other small fishes. The usual implement of capture at first was the harpoon, but, now that its flesh has become valuable for canning and when marketed fresh, it is taken in pound nets and by line fishing. The fish arrives on the coast in poor condition and without value, but becomes very fat during the summer months, and is then utilized for the oil, which is obtained from the head and belly by boiling, and for its flesh, which is favorably regarded, either fresh, salted or preserved in cans.

The Tunny is said to spawn in June, and the recently hatched young, according to Yarrell, weigh $1\frac{1}{2}$ ounces, growing to 4 ounces by August and 30 ounces in October. Adults often weigh 1,000 pounds. The Killer Whale is the most dreaded enemy of the Tunny.



TUNNY.

In Southern California this fish is highly prized by anglers who are fond of big game and hard play. In the Bay of Chaleur and off Caraquette, in the Gulf of St. Lawrence region, 100 Tunny were captured by means of baited lines, and the fishing was considered exciting because the fish pulled with such violence as to endanger the lives of the fishermen by dragging them overboard. This kind of exercise might be had near Rockport, Mass., or off the New Jersey coast annually in summer.

85. Bonito (*Sarda sarda* Bloch).

Pelamys sarda DEKAY, N. Y. Fauna, Fishes, 106, pl. 9, fig. 27, 1842.

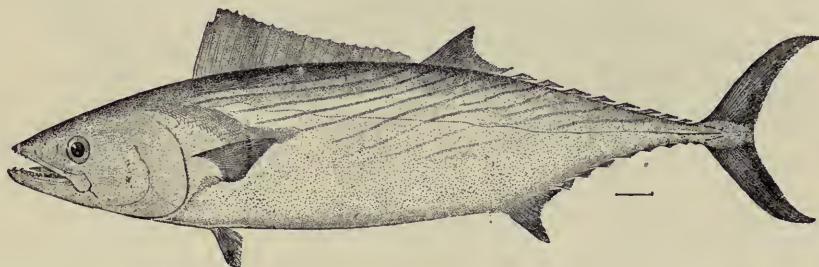
Sarda sarda BEAN, Bull. U. S. F. C., VII, 138, 1888; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 872, 1896; BEAN, Bull. Am. Mus. Nat. Hist., IX, 360, 1897, Gravesend Bay.

Color steel blue above, the sides silvery, the abdomen and under surface of head silvery white; from 10 to 20 dark bluish, narrow bands obliquely downward and for-

ward from the back, some of them almost reaching the belly; iris yellowish; first dorsal fin sometimes pale, sometimes nearly black; pectoral dark above, light beneath.

The Bonito inhabits the Atlantic Ocean on both coasts and is common in the Mediterranean. On our coast it ranges habitually north to Cape Ann. It reaches the length of 30 inches and the weight of 10 or 12 pounds. Though not generally esteemed as a food fish, it meets with a steady sale either fresh or salted like the Mackerel. The fish is believed to live in the open sea, coming to the shores only to feed or to deposit its eggs. It is predaceous and active, feeding insatiably on Mackerel and Menhaden; it takes trolling bait as freely as the Bluefish, to which it is not inferior in quality of flesh.

The fish is generally scarce in Gravesend Bay. Five were taken in one day in a pound net in October, 1897, an unusual number for that species. The Bonito will not live in captivity.



BONITO.

86. Spanish Mackerel (*Scomberomorus maculatus* Mitchill).

Cybius maculatum DEKAY, N. Y. Fauna, Fishes, 108, pl. 73, fig. 232, 1842, N. Y.

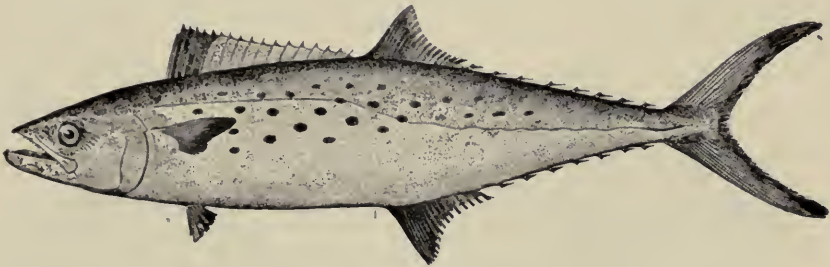
Scomberomorus maculatus JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 426, 1883, BEAN, Bull. U. S. F. C., VII, 138; 19th Rept. N. Y. Comm. Fish., 254, pl. VII fig. 9, 1890; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 874, 1896, pl. CXXXIV, fig. 368, 1900.

Color silvery; upper parts bluish; sides with numerous oblong spots of a dull orange, none of them more than one-third as long as the snout, these spots fully as numerous above the lateral line as below it; the membrane connecting the first eight spines of the dorsal black, the rest of the fin white; soft dorsal with a yellowish tinge, its margin dark; anal and ventral white; pectoral black inside, yellowish with dark borders outside and covered with dusky points; caudal dusky except at base.

The Spanish Mackerel inhabits the Atlantic and Pacific coasts of North America,

on our coast ranging north to Maine and south to Brazil. It is one of the choicest of our food fishes and grows to the length of 3 feet and the weight of 10 pounds. The species spawns on the Long Island coast in August or earlier. The eggs are very small, about one twenty-fifth of an inch in diameter, and they float in salt water. The rate of growth is unknown, as the young are seldom or never seen by persons who know the fish. The Spanish Mackerel is caught chiefly in pound nets.

It is recorded that the species has been obtained off the coast of Maine by Capt. Atwood. Mitchill describes the species without making any remark on its abundance or scarcity, and states that it comes in July. In 1854 the species had very little importance in the New York market, but at the present time it is one of the most highly prized fishes and is obtained in large numbers. Spanish Mackerel have been sparingly caught by trolling off Fire Island Inlet. We did not obtain the species in



SPANISH MACKEREL.

Great South Bay, but Erastus Gordon, of Patchogue, informed us that it is obtained in moderate numbers. In 1884 the fish was not plentiful and the average price was about \$1 each. They appear in New York waters in July and usually leave in September. The spawning season at Long Island begins late in August and continues about a month. The Spanish Mackerel congregate in enormous schools. Mr. Earll records the appearance of a school off Long Island which was estimated to contain several million individuals. The fish are taken principally in traps; a few are caught by trolling, but this is an unsatisfactory method of capture.

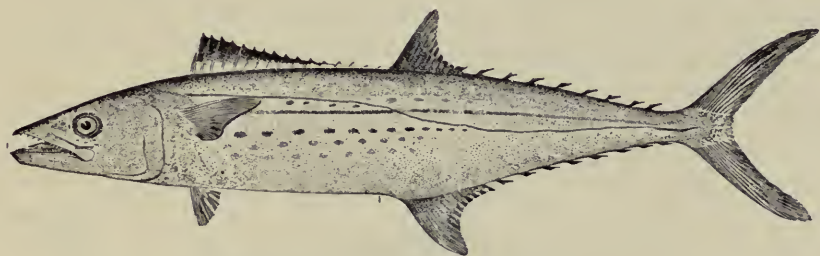
87. Cero (*Scomberomorus regalis* Bloch).

Scomberomorus regalis JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 426, 1883; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 875, 1896, pl. CXXXV, fig. 369, 1900.

Color silvery; a narrow longitudinal stripe of brownish or bronze beginning behind the pectoral and running to base of caudal; numerous oblong brownish

spots mostly below this stripe, none of them more than one-half the diameter of eye; upper anterior part of spinous dorsal black, the rest of the fin white.

The Spotted Cero is found from Cape Cod to Brazil, but is not common northward; it is abundant in the West Indies. The species grows to the length of 5 feet and the weight of 20 pounds; it is a fish of the same good qualities as the Spanish Mackerel and is readily caught by trolling.

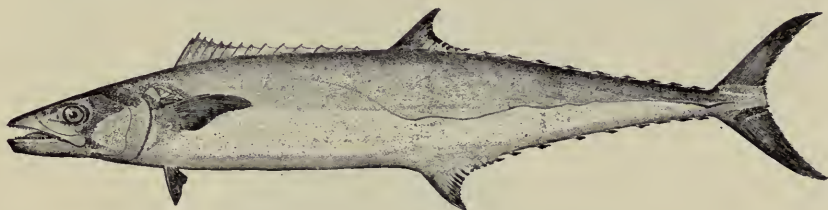


CERO.

88. Kingfish; Sierra (*Scomberomorus cavalla* Cuvier).

Scomberomorus cavalla JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 427, 1883;
JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 875, 1896.

Color grayish silvery, the sides sometimes with dark spots, or yellowish in the young; spinous dorsal blackish above, or without dark blotch.



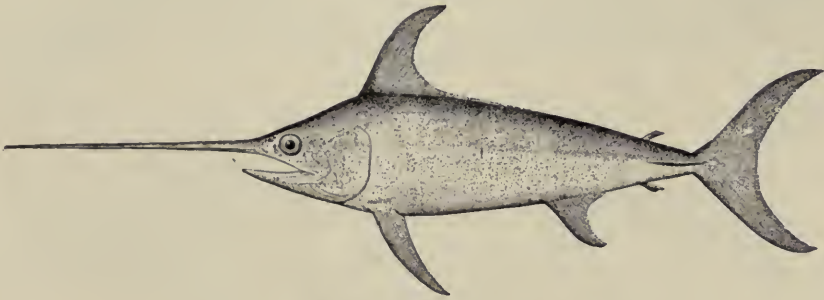
KINGFISH.

The Kingfish, or Cavalla, is a very important and valuable food fish of the tropical Atlantic, coming in immense numbers to the Florida Keys, the West Indies, and north to Charleston, occasionally, in summer, to Cape Cod. Southward it extends to Africa and Brazil, frequenting the open seas. In habits it resembles the Spanish Mackerel; it is caught by trolling, and at Key West it is so abundant that two men in a small sailboat sometimes catch more than 100 in a day. The flesh is excellent, either fresh or smoked.

89. Swordfish (*Xiphias gladius* Linnæus).

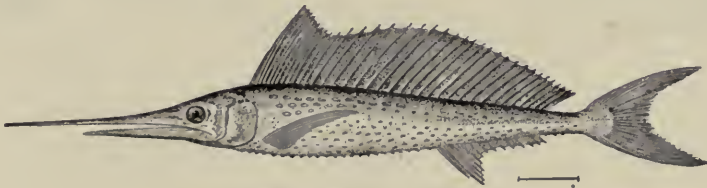
Xiphias gladius DEKAY, N. Y. Fauna, Fishes, III, pl. 26, fig. 79, 1842; JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 420, 1883; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 894, 1896.

Color above rich purplish blue, shading into whitish beneath, the sides and belly with a silvery lustre. Fins, dark bluish with silvery sheen, except dorsal. Top of head rich purplish blue, the color extending upon the rostrum. Lower side of rostrum rich brownish purple. Eye deep blue.



SWORDFISH—ADULT.

The Swordfish inhabits the Atlantic and comes near both coasts; it is most abundant between Cuba and Cape Breton, rather common in the Mediterranean, and is occasionally taken off Southern California. The fish appear in the vicinity of Sandy Hook about June first, and the fishing season continues as far east as Martha's Vineyard and Nantucket Shoals till about the middle of September.



SWORDFISH—YOUNG.

They disappear to the southward as soon as the cold winds begin to blow. They feed on Mackerel, Menhaden and Squid. They are often caught on trawl lines, but the chief means of capture is the harpoon.

The average length of Swordfish is 10 feet, but individuals measuring 16 feet are on record. An individual weighing 750 pounds was killed in 1874 off Portland.

The flesh of this fish is very palatable, and the fishery is an important one as well as an exciting occupation.

Young Swordfish have the skin covered with small, rough excrescences, the jaws much more nearly equal, and the dorsal and anal fins not divided into two separate parts.

90. **Yellow Mackerel** (*Caranx hippos* Linnæus).

Scomber hippos LINNÆUS, Syst. Nat. ed., XII, I, 494, 1766, Charleston, South Carolina.

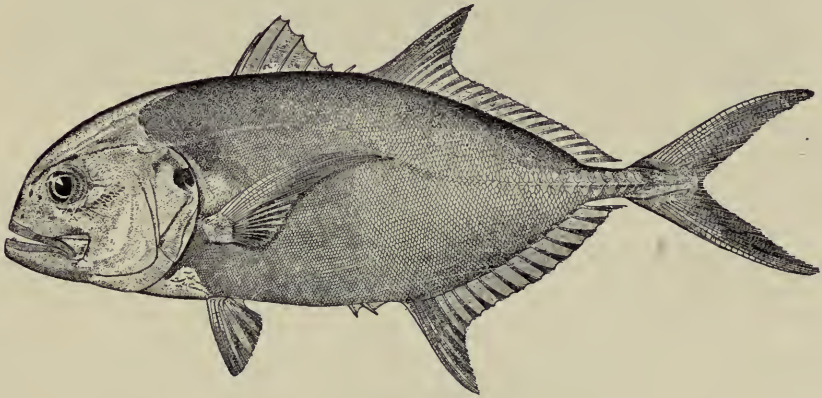
Caranx carangus CUVIER & VALENCIENNES, Hist. Nat. Poiss., IX, 91, 1833; GÜNTHER, Cat. Fish. Brit. Mus., II, 448, 1860.

Caranx defensor DEKAY, N. Y. Fauna, Fishes, 120, pl. 24, fig. 72, 1842; HOLBROOK, Ichth. S. C., 87, pl. 12, fig. 1, 1860.

Carangus hippos GILL, Proc. Ac. Nat. Sci. Phila., 433, 1862; GOODE & BEAN, Bull. Essex Inst., XI, 16, 1879.

Caranx hippos JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 437, 1883; Proc. U. S. Nat. Mus., 200, 1883.

Caranx hippos BEAN, Bull. U. S. F. C., VII, 139, 1888; Bull. Am. Mus. Nat. Hist., IX, 362, 1897; 52d Ann. Rept. N. Y. State Mus., 103, 1900; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 920, 1896, pl. CXLI, fig. 387, 1900; MEARNs, Bull. Am. Mus. Nat. Hist., X, 318, 1898; SMITH, Bull. U. S. F. C., XVII, 98, 1898.



YELLOW MACKEREL.

Body oblong, the anterior profile very strongly arched. The depth is contained two and one-half times in the length. Head large and deep, its length being contained three and one-half times in that of the body; mouth large, low; lower jaw prominent, maxillary extending to nearly opposite posterior border of eye, two and one-third in head; teeth in upper jaw in a broad villiform band, an outer series of large, wide-set, conical teeth, teeth of lower jaw in one row, a distinct canine on each side of symphysis; villiform teeth on vomer, palatines, pterygoids, and tongue; lateral line with a wide arch, its length one and one-third in straight part, the angle under fifth dorsal ray, plates not covering all of the straight part,

lateral line (scutes) about 30; dorsal spines short, rather stout; gill rakers stout, rather long, 15 below angle; occipital keel sharp; eye not very large; pectoral falcate, one-fifth longer than head; breast naked or with only a small triangular patch of scales in front of ventrals; caudal lobes equal, nearly as long as head. D. VIII-I, 20; A. II-I, 17.

Olivaceous above, sides and below golden; a large, distinct black blotch on opercle, bordered behind with pale; a large faint black spot on lower rays of pectorals, the latter sometimes wanting in young; axil of pectoral with a black blotch; edge of soft dorsal black; upper edge of caudal peduncle dusky.

The Yellow Mackerel is a widely distributed fish in warm seas; it is recorded from the East Indies, both coasts of tropical America, and northward to Cape Ann and the Gulf of California. The young are common at Woods Hole, Mass., where they appear in July and become most abundant in October. Individuals 1 inch long have been obtained there about July 1; larger fish occur in the fall. In August, 1898, only a few young ones were secured in Great South Bay and at Southampton, L. I.

The fish probably spawns in West Florida in May in the salt water bayous, as the young fish are seen coming out of such places in schools in the fall on their way to the sea. Fish weighing about a pound or two are considered equal to Pompano for the table, but large fish are not esteemed, the flesh being dark and almost tasteless. The species reaches the weight of 20 pounds.

The Yellow Mackerel resembles the Big-eyed Scad in its endurance of captivity and its feeding habits. At the end of November it has been known to thrive in a pool containing about 50,000 gallons of water in company with the Crevallé, the Big-eyed Scad and other species.

91. Crevallé (*Caranx crysos* Mitchill).

Scomber crysos MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 424, 1815, New York.

Caranx chrysus JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 970, 1883; BEAN, 19th Rept. N. Y. Com. Fish., 256, pl. VII, fig. 10, 1890.

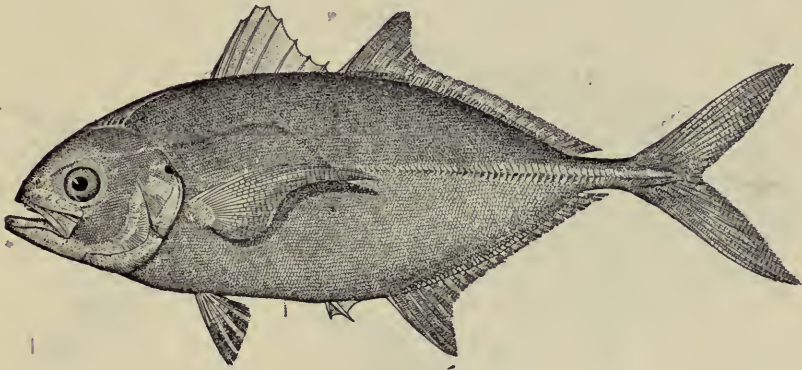
Caranx crysos DEKAY, N. Y. Fauna, Fishes, 121, pl. 27, fig. 85, 1842; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 921, 1896, pl. CXLII, fig. 388, 1900; BEAN, Bull. Am. Mus. Nat. Hist., IX, 362, 1897; SMITH, Bull. U. S. F. C., XVII, 98, 1898.

Greenish olive, golden yellow or silvery below; a black blotch on opercle; fins all pale. An individual $3\frac{1}{2}$ inches long, taken at Beesley's Point, N. J., August 11, 1887, showed the following colors: Caudal yellow; basal half of elevated part of

anal yellow ; cheeks and lower half of sides also yellow ; a black opercular spot, but none on pectoral ; several narrow pale bars on sides ; tip of elevated part of soft dorsal dusky ; membrane between dorsal spines dusky ; iris copper color.

The Crevallé is found on the east coast from Nova Scotia southward, ranging to the West Indies and Brazil. The young are very common along the coast of Southern New England in summer. DeKay calls it the Yellow Caranx, and Mitchill mentions it as the Yellow Mackerel. The specimens seen by both these authors came from the Bay of New York.

At Woods Hole, Mass., the young arrive in July and leave in October. In Great Egg Harbor Bay, N. J., young individuals were taken sparingly in August. DeKay records the species as abundant in New York Bay in September and October. The writer saw several examples from a fish trap at Islip, L. I., October 1, 1890.



CREVALLÉ.

Young Crevallé make a croaking sound when captured in a net or held in the hand.

On the Gulf coast of Florida, Alabama and Mississippi the fish is migratory, just as it is here ; it makes its appearance in April, spawns in July or August, and then disappears and is replaced by the young. It feeds on small fish, which it pursues eagerly, and is preyed on by sharks and porpoises.

It grows to the length of 15 inches and is highly prized for food.

The Crevallé can be successfully kept in captivity in large pools with a temperature above 50° in winter. The fish occasionally school together under a large shark and follow it about.

92. Common Pompano (*Trachinotus carolinus* Linnæus).

Lichia carolina DEKAY, N. Y. Fauna, Fishes, 114, pl. 10, fig. 30, 1842, off Sandy Hook.

Trachynotus carolinus JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 442, 1883.

Trachynotus carolinus BEAN, Bull. U. S. F. C., VII, 140, 1888; 19th Rept. N. Y. Comm.

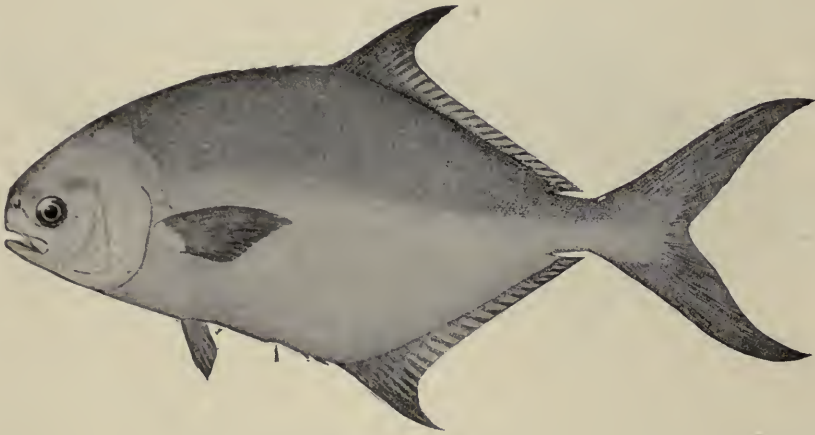
Fish., 254, pl. VIII, fig. 11, 1890.

Trachinotus carolinus BEAN, Bull. Am. Mus. Nat. Hist., IX, 363, 1897, 52d Ann. Rept.

N. Y. State Mus., 104, 1900.

Uniform bluish above, sides silvery, golden in the adult, without bands, fins plain silvery or dusky.

This fish has no other name on our east coast except the southern variation of Pompeynose. In Great South Bay the name Butter fish is applied to it because it is confounded with the *Poronotus triacanthus*, to which the name properly



COMMON POMPANO.

belongs. Mitchill described it under the name Thornbacked Grunt, a name not now in use.

The Pompano ranges on our coast from Cape Cod to Florida, the adults rarely or never coming into northern waters, but the young are taken in variable numbers every year. At Woods Hole they sometimes occur in considerable numbers, and they have been taken in great abundance in Great Egg Harbor Bay, but not recently. In Great South Bay, in 1890, only a single young individual was secured at Oak Island Beach on the last day of September. It occurs occasionally also on the Pacific coast. Dr. DeKay, in 1842, mentioned it as an exceedingly rare species on the New York coast. His description was based on a specimen taken off Sandy Hook more than 20 years before. In 1898 young specimens were found in moderate numbers at Oak Island Beach, Great South Bay, September 14, and on the east side

of Fire Island Beach September 16. The young are summer and fall visitors in Gravesend Bay. Twenty-two individuals were placed in a tank in August, 1897, and grew rapidly till the temperature of the water fell below 60° F. in November. During this month all of them died.

The species reaches the length of 20 inches. It is one of the finest of our food fishes.

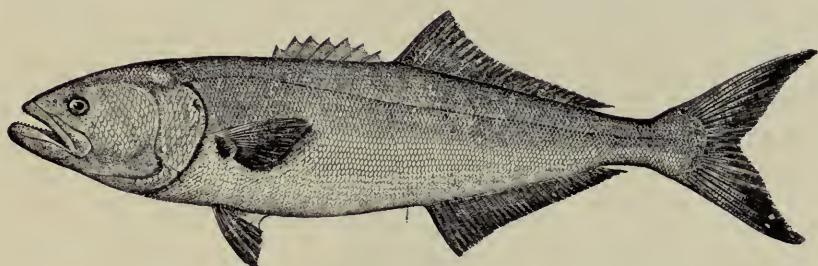
93. Bluefish ; Snap Mackerel ; Snapper (*Pomatomus saltatrix* Linnæus).

Scomber plumbeus MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 424, pl. IV, fig. 1, 1815.

Temnodon saltator DEKAY, N. Y. Fauna, Fishes, 130, pl. 26, fig. 81, 1842.

Pomatomus saltatrix JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 914, 1883.

Pomatomus saltatrix BEAN, Bull. U. S. F. C., VII, 1888 ; 19th Rept. N. Y. Comm. Fish., 269, pl. XX, fig. 24, 1890 ; Bull. Am. Mus. Nat. Hist., IX, 363, 1897 ; 52d Ann. Rept. N. Y. State Mus., 104, 1900.



BLUEFISH.

Bluish or greenish, silvery below, a black blotch at the base of the pectoral.

Some of the many names applied to this widely distributed fish are the following: Mackerel (New Jersey), Horse Mackerel (New York and Rhode Island), Snapping Mackerel (New England and New Jersey), Skip Mackerel (New York), Snapper and Blue Snapper (New England), Green Fish (Maryland, Virginia and North Carolina), Salt-water Jack (Southern States), Tailor (Chesapeake Bay), Whitefish (Hudson River). Bluefish is the name most extensively used on the coast and in the Gulf of Mexico.

The Bluefish ranges on our coast from Maine to the Gulf of Mexico, and is believed to frequent warm seas of both continents. It ranged farther to the northward in 1887 than for many years before. We heard of its capture in the vicinity of Mount Desert, Me. On our coast and elsewhere its movements are erratic, and its abundance fluctuates greatly within certain periods; it disappears sometimes altogether for a term of years. The young, under about 1 inch in length, seem to be unknown. The spawning habits and localities have not been recorded. The

smallest known examples were obtained at the surface off shore by the U. S. Fish Commission. The writer has seined individuals a little more than an inch long at Ocean City, N. J., the last of August. The young ascend rivers into fresh water.

This is one of the most destructive of all fishes. It feeds ravenously, and, when gorged with food, continues to destroy its victims for the sake of gratifying its killing propensity. It follows the great schools of Alewives, Weakfish, Mulletts and other valuable food fishes along our coast in summer, and the young may be discovered in shallow bays and sounds, pursuing the Silversides, young Herring, Anchovies and other fishes smaller than themselves. According to DeKay Bluefish were unknown on the New York coast till about 1810, when a few appeared. In 1815 Dr. Mitchill wrote: "Young ones are taken plentifully with the hook at our wharves by the boys in August." The largest mentioned by Mitchill was 13 inches long, 3 inches deep and weighed about 14 ounces. The name Bluefish was in use at the time of Mitchill's report.

DeKay noticed the gradual disappearance of the Weakfish with the increasing abundance of Bluefish.

The best known methods of taking Bluefish are by trolling at the surface with a squid of metal or bone and by heaving and hauling in the surf near the mouths of streams into which Alewives are running. Artificial minnows are also used with a light rod, when young Bluefish are seen feeding near the surface. The most recent method in use by anglers is that of chumming in the manner usually employed in Striped Bass fishing. This method, which involves the use of rod and reel, was in use near the inlet at Fire Island early in October, 1890. During the summer, in this bay, it was not an uncommon thing for anglers to catch 150 or 200 small Bluefish with hook and line in a single day. The species is to be found in all parts of the bay visited by us. It was taken at the following localities: Blue Point Cove, Oak Island and Fire Island. Large numbers of Bluefish were caught late in September by means of gill nets set in the ocean near Blue Point life-saving station. A fisherman caught 450 at one time and 250 at another, the dates being September 23 and 24, 1890. In August of that year Bluefish drove immense schools of Round Herring (*Etrumeus teres*) on the ocean beach, near the Life-saving station. September 24, while walking along the beach of East Island, not far from the Blue Point station, in a distance of half a mile, I saw 51 Round Herring lying on the beach, having been chased in a short time previously by Bluefish. When the fishermen find the Round Herring on the shore, they know that Bluefish are present. Small Bluefish were caught in a trap at Islip, October 1, 1890. In the summer of 1898

young Bluefish were abundant in all the waters visited in Peconic Bay and Great South Bay and were taken as late as October 16.

During the warm season they often run up the rivers, the young, called Snappers, frequently into nearly fresh waters. (After Eugene Smith.)

The Bluefish is so active in its movements that it is difficult to keep it in captivity. As with the species of *Caranx* and *Seriola*, however, its longevity depends on range and temperature; in a large body of water, not colder than 60° in winter, it can be maintained easily.

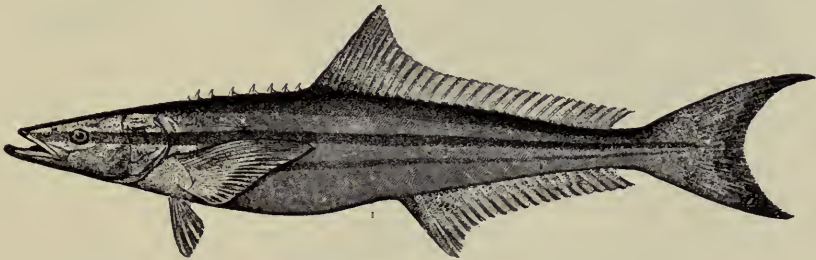
94. Crab-eater; Cobia (*Rachycentron canadus* Linnæus).

Centronotus spinosus MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 490, pl. III, fig. 9, 1815, New York.

Elacate atlantica CUVIER & VALENCIENNES, Hist. Nat. Poiss., VIII, 334, pl. 233, 1831, Brazil; DEKAY, N. Y. Fauna, Fishes, 113, pl. 25, fig. 77, 1842.

Elacate canada JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 418, 1883; BEAN, Bull. U. S. F. C., VII, 144, pl. II, fig. 13, 1888; 19th Rept. N. Y. Comm. Fish., 270, pl. XX, fig. 25, 1890, young, Great Egg Harbor Bay.

Rachycentron canadus JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 948, 1896, pl. CXLVIII, fig. 401, 1900; SMITH, Bull. U. S. F. C., XVII, 98, 1898.



CRAB-EATER.

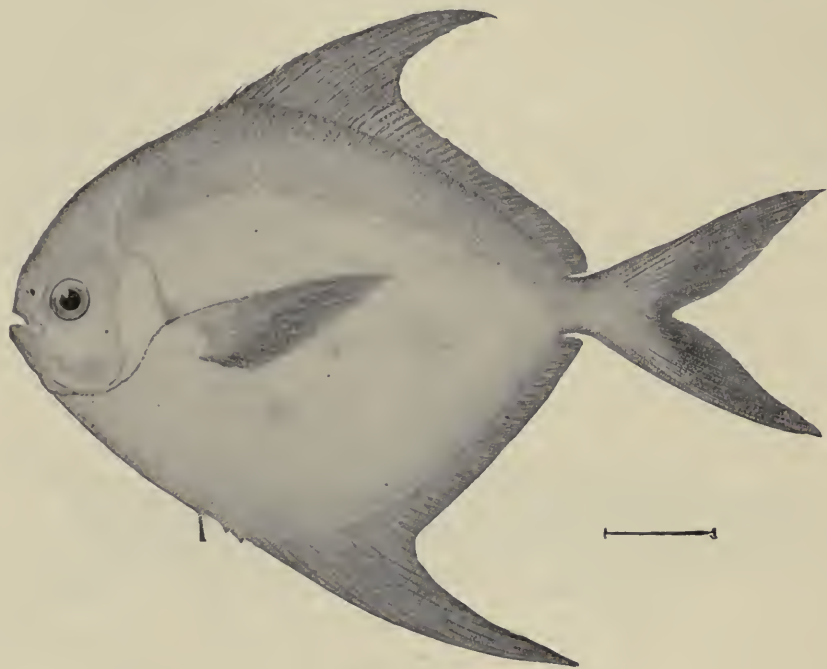
Color olive brown; sides with a distinct broad dark band and a less distinct band above and below it; lower parts silvery.

The Crab-eater inhabits all warm seas, occasionally appearing on our northern coast in summer and ranging northward to Massachusetts Bay. Individuals are occasionally taken at Woods Hole, Mass.

Dr. Mitchill had a specimen of the Crab-eater which was caught in New York Bay June 11, 1815. He found in its stomach 20 spotted Sand Crabs and several young Flounders. The fish was eaten at his table, and pronounced one of the best he had ever tasted. This example was 31 inches long. Dr. DeKay styles it the Northern Crab-eater. The specimen described by him was captured in Boston Harbor, and placed in a live car with other fish, chiefly Porgies (*Stenotomus chrysops*),

and it destroyed and ate every fish in the car. Dr. A. K. Fisher of Washington has found the young of the Crab-eater in the Hudson near Sing Sing. Though we have no specimens of the Crab-eater from Great South Bay, there is scarcely a doubt of its occurrence in that body of water.

A young example, $3\frac{7}{8}$ inches long, was caught at Somers Point, N. J., near the club house, August 2, 1887, by Capt. Richard Chamberlain. Ground color nearly black; a white stripe, about as wide as pupil, from upper angle of gill opening to caudal; another one, but narrower, begins at lower extremity of pectoral base, curves very slightly upward, fading out near the tail; upper caudal lobe with a narrow



HARVEST FISH.

whitish margin along its upper surface, relieved by a trace of orange red at its base; lower caudal lobe with a narrow orange red margin; pectorals, ventrals and caudal black; back fades to a dark green; belly grayish white; iris golden bronze. This species has not previously been recorded from Great Egg Harbor Bay, and the young seems not to have been described.

Another example, 4 inches long, was seined in one of the thoroughfares in the bay August 23. This has the same markings as the first. The caudal when fully expanded, is rounded, the end truncate; there is no emargination as in the adult. A figure of the young is published in Bulletin of the U. S. Fish Commission, pl. 2, fig. 13, 1888.

95. Harvest Fish ; Pappy Fish (*Rhombus paru* Linnæus).

Stromateus longipinnis MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 366, 1815, New York Bay.

Rhombus longipinnis DEKAY, N. Y. Fauna, Fishes, 136, pl. 75, 239, 1842.

Rhombus paru JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 965, 1896, pl. CL, fig. 404, 1900 ; BEAN, Bull. Am. Mus. Nat. Hist., IX, 364, 1897.

Color greenish above, golden yellow below. Mitchill gives the following description: "Silvery, with tints of blue, green and iridescent; dusky on the head and with inky patches on the belly towards the tail, which in certain lights appear beautifully red and purple; back bluish, with occasional clouds."

The Harvest Fish inhabits the West Indies and is found on our Atlantic coast from Cape Cod southward, ranging to Brazil. The young are frequently seen swimming beneath the Portuguese Man-of-War.

DeKay had several specimens of the species, but found it less common than the Short-finned Harvest fish, *R. triacanthus*. At Charleston the fish is called Rudder fish.

The species reaches a length of 8 inches. It is a valuable food fish. It is a summer visitor in Gravesend Bay and is sometimes rare, but was formerly abundant there. It is not adapted to a captive life. At Woods Hole, Mass., Dr. Smith reports it as usually rare, but occasionally common. As a rule only 3 or 4 are taken in a season, but one year 300 or 400 were obtained. It occurs mostly in June and July, associated with the Butter fish, *R. triacanthus*.

96. Butter fish ; Harvest fish (*Rhombus triacanthus* Peck).

Stromateus cryptosus MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 365, pl. I, fig. 3, 1815, New York Bay.

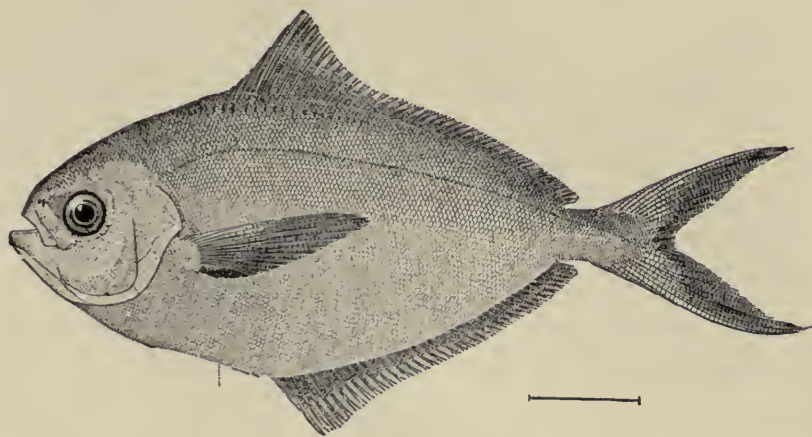
Rhombus triacanthus DEKAY, N. Y. Fauna, Fishes, 137, pl. 26, fig. 80, 1842 ; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 967, 1896, pl. CL, fig. 405, 1900 ; BEAN, Bull. Am. Mus. Nat. Hist., IX, 363, 1897 ; BEAN, 52d Ann. Rept. N. Y. State Mus., 104, 1900.

Poronotus triacanthus BEAN, 19th Rept. N. Y. Com. Fish., 257, pl. XI, fig. 14, 1890.

This is known as the Dollar fish, Harvest fish and Lafayette. Mitchill called it the Cryptous Broad Shiner, and DeKay described it under the name Short-finned Harvest fish. About Cape Cod it is the Sheepshead and Skipjack. In Connecticut it is called Pumpkin Seed and at Norfolk, Starfish.

The Butter fish ranges from Maine to South Carolina, and is gradually replaced southward by the Long-finned Harvest fish, *Rhombus paru*. It is a summer visitor, associated with the Mackerel. DeKay records it in New York Bay July 1, and obtained it from fyke nets in New York Harbor as late as October 12. We seined young examples at Blue Point Life-saving station October 7, and others were secured September 30 at Oak Island Beach. It is taken chiefly in pound nets, and has recently become a highly prized market fish. A few years ago it was little esteemed. The young are to be found in the summer months swimming at the surface in sheltered bays and frequently under the shelter of the streamers of Jelly fishes, where they are sometimes destroyed by the lasso cells of their host.

The Harvest fish is present in Gravesend Bay from April to November. Adults were taken at Southampton Beach August 1 and August 3, 1898. The fish was not found in Great South Bay during the summer and fall of 1898.



BUTTER FISH.

97. Crappie (*Pomoxis annularis* Rafinesque).

Pomoxis annularis BEAN, Fishes Penna., 103, pl. 30, fig. 59, 1893; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 987, 1896, pl. CLIV, fig. 415, 1900.

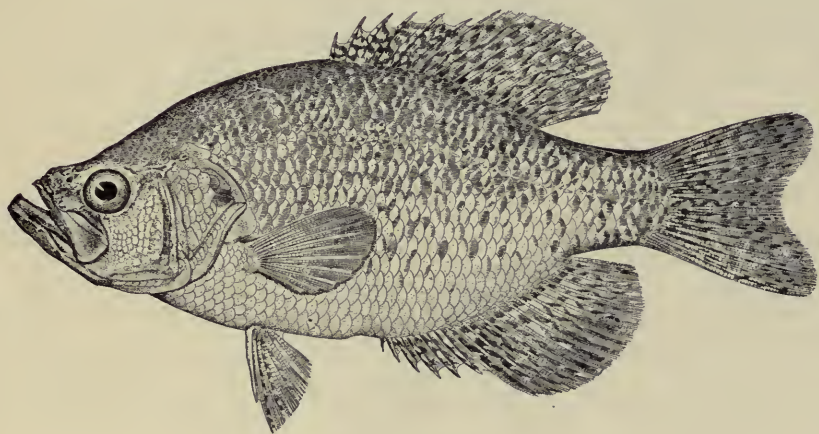
Color clear silvery olive, the sides mottled with dark greenish blotches. On the upper part of the body are traces of narrow vertical bars. The dorsal and caudal are mottled, but the anal is usually uniform pale.

Among the many names which have been applied to the Crappie are: Bachelor, Newlight, Campbellite, *Sac-a-lait*, Bridge Perch, Strawberry Perch, Chinquapin Perch, Speckled Perch, Tin Perch, Goggle-eye, John Demon, Shad, White Croppie and Timber Croppie.

In the lower Mississippi Valley the Crappie is one of the most common fishes. It is abundant also in the Ohio Valley and occurs rarely in Lake Erie. The Ohio, Illinois and Mississippi Rivers are particularly noted for an abundance of Crappies, and the fish is very plentiful in Lake Pontchartrain, La., where it is one of the most highly prized of the smaller game fishes.

Dr. Meek did not obtain the Crappie in the Cayuga Lake basin, but says it may be found in the canal near Montezuma, where the Calico Bass is said to be frequently taken.

The Crappie is a very general favorite for pond culture, can be readily transported and under favorable conditions multiplies prodigiously. Its range has been very much extended by artificial means. The best distinguishing marks between



CRAPPIE.

the Crappie and the Calico Bass are the more elongated form of the Crappie, the presence of six spines in the dorsal and the nearly uniform whitish color of the anal. In the Crappie the greatest depth of the body is usually contained two and one-half times in the total length without the tail, while in the Calico Bass the depth equals one-half the length. These two species are so similar in size and habits that they are rarely distinguished except by ichthyologists.

The Crappie grows to a length of about 1 foot and usually weighs 1 pound or less, but in a lake near St. Louis an individual weighing 3 pounds has been recorded.

Crappie fishing usually begins in June and lasts till the coming of cold weather. Large numbers of these fish are collected near Quincy, Ill., for distribution to other waters. At Peoria, Ill., Prof. Forbes has taken them in March and April; he has found them also in Pistakee Lake and at Ottawa. Cedar Lake, Ind., and King's Lake, Mo., are celebrated Crappie waters. Near Covington, Ky., in private ponds

belonging to Joseph Schlosser, there are myriads of Crappies as well as other game fishes.

Prof. S. A. Forbes has studied the feeding habits of the Crappie, and finds that the young live chiefly on entomostraca and small insect larvæ. The adults subsist on the same food when obtainable, but in times of scarcity they feed to some extent on other fishes. Small Minnows and Darters have been found in their stomachs. In the autumn Prof. Forbes has found a larger percentage of small fishes, sometimes constituting nearly two-fifths of their food. The Hellgramite is eaten by the Crappie. In cold weather it does not consume one-fourth the amount of food which it takes in the early spring. The Crappie prefers still waters, thriving even in warm and muddy water, and has been taken in large numbers in midsummer at depths of only a few feet; in cold weather it retires to deeper water, becomes rather sluggish and takes little food. Dr. Henshall states that the Crappie is found about dams and in deep, still parts of streams and ponds, especially about logs, brush and drift.

The Crappie is a very free biter and can be caught readily with Minnows or worms. Spoon bait has been successfully used in trolling for this species. It is recorded that two men have taken a thousand Crappies in three days' fishing with hook and line. As the fish is gregarious, congregating in large schools, and fearless, it can be taken in the immense numbers given. The best bait for Crappie is a small Shiner. It rises well also to the artificial fly. As a food fish this is one of the best in our inland waters, and its adaptability for life in artificial ponds should make it a favorite with fish culturists.

98. Calico Bass ; Strawberry Bass (*Pomoxis sparoides* Lacépède).

Pomoxys sparoides JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 465, 1883; BEAN, Fishes Penna., 102, color pl. 9, 1893.

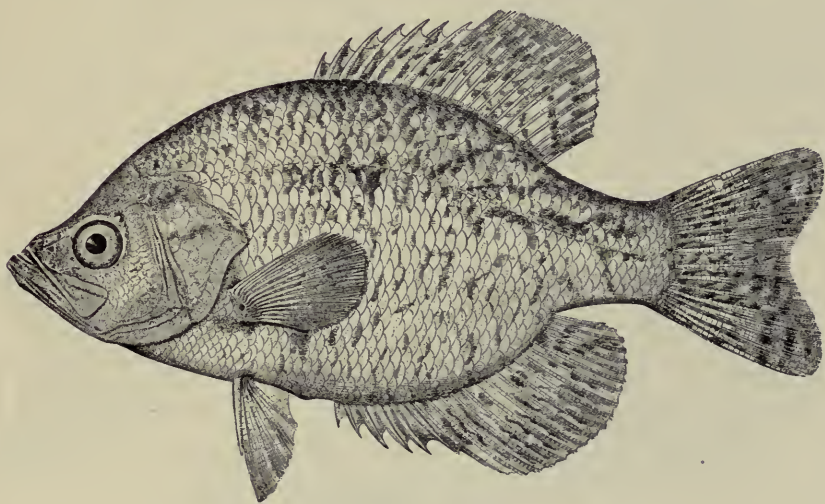
Pomoxis sparoides MEEK, Ann. N. Y. Ac. Sci., IV, 312, 1888; BOLLMAN, Rept. U. S. F. C., XVI, 559, pl. 68, fig. 2, 1892; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 987, 1896, pl. CLIV, fig. 416, 1900.

The sides are olivaceous with silvery reflections and mottled with pale green. The dorsal, anal and caudal show pale spots surrounded by green reticulations.

The Calico Bass, on account of its wide distribution and variability, has received a profusion of names. Many of these are variations of the term bass. It is known, for example, as Strawberry Bass, Grass Bass, Lake Bass, Lake Erie Bass, Bank Lake Bass, Silver Bass, and Big-fin Bass. Other names for the species are Strawberry Perch, Chinquapin Perch, Goggle-eye Perch, Silver Perch and Sand

Perch. Still other names of local application are Barfish, Bitter Head, Tin Mouth, *Sac-a-lait*, Lamp-lighter, Razor Back, Goggle-eye, Black Croppie and Lake Croppie. The species is mentioned in the fish laws of Pennsylvania under the name of Lake Erie Bass or Grass Bass.

The distribution of the Calico Bass is naturally extensive, and it has been still farther increased by artificial introduction. The fish has been carried to France, and examples measuring about 8 inches in length were recorded there several years ago. There is, however, some confusion in that country between the Calico Bass and the Common Sunfish, and there is no doubt that some of the latter species have been introduced into Germany under the mistaken belief that they were Calico Bass.



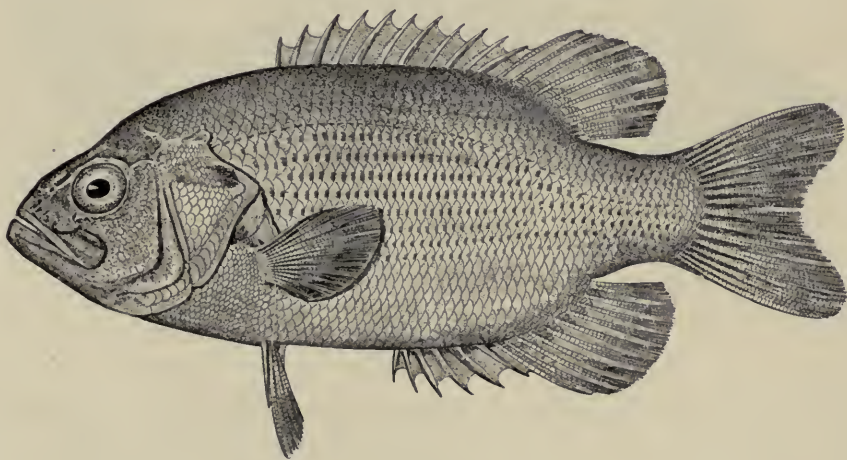
CALICO BASS.

This Bass is indigenous east of the Alleghanies from New Jersey southward to Georgia. It abounds in the Great Lakes region, Mississippi Valley south to Louisiana, most common northward, and occurs in the Missouri. In the Ohio Valley it was rather uncommon till its introduction in large numbers. It was introduced into the Susquehanna River by the Pennsylvania Fish Commission, and has become acclimatized there; also into the Monongahela, the Lehigh, and other waters.

Fishermen of the region about Montezuma informed Dr. Meek that the fish is frequently taken from the canal near that place, where it is known as Calico Bass. The U. S. Fish Commission obtained two examples in Long Pond, at Charlotte, N. Y., August 17, 1894.

This bass grows to a length of about 1 foot and a maximum weight of nearly 3 pounds, but the average weight is about 1 pound. It spawns in the spring, and the close season in some States extends to June 1. Gravid females were caught near

Havre de Grace, Md., in May. These were taken in the Susquehanna and Tidewater Canal, where the species is becoming rather abundant. The food of the Calico Bass consists of worms, small crustaceans and fishes. Though a native of deep, sluggish waters of western rivers and lakes, it readily adapts itself to cold, rapid streams and thrives even in small brooks. The species is suitable also for pond life and may be kept in small areas of water provided they have sufficient depth. It does not prey on other fishes, and its numerous stiff spines protect it from larger predaceous species. It swims in large schools and is often found in comparatively shoal water. The nest-building habits have been described by Duclos from observations made at Versailles, France. This writer unfortunately had under observation both the Calico Bass and the Common Sunfish, and his statements need confirmation. The game qualities of this bass are noteworthy. It is a free, vigorous biter; its endurance is rather remarkable considering its size. As a food fish the species is highly prized, and its increase in eastern rivers is greatly to be desired.



ROCK BASS.

99. Rock Bass; Red-eye (*Ambloplites rupestris* Rafinesque).

Centrarchus aeneus DEKAY, N. Y. Fauna, Fishes, 27, pl. 2, fig. 4, 1842, Lake Champlain; Great Lakes; streams of Western New York; Hudson River.

Ambloplites rupestris BEAN, Fishes Penna., 105, color pl. 10, 1893; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 990, 1896, pl. CLVI, figs. 419, A, B, C; MEEK, Ann. N. Y. Ac. Sci., IV, 313, 1898; EUGENE SMITH, Proc. Linn. Soc. N. Y. for 1897, 33, 1898; MEARNs, Bull. Am. Mus. Nat. Hist., X, 319, 1898; BEAN, 52d Ann. Rept. N. Y. State Mus., 104, 1900.

Color olive green with a brassy tinge and much dark mottling; the young are pale or yellowish, irregularly barred and blotched with black; adults with a dark

spot at the base of each scale, the spots forming interrupted black stripes; a dark spot on the opercle; soft dorsal, anal, and caudal fins with dark mottlings; iris golden overlaid with crimson.

The Rock Bass is known under a variety of names. Among them are the following: Red-eye, Red-eyed Perch, Goggle-eye and Lake Bass. It is found in Lower Canada, Vermont and throughout the Great Lakes region, West Manitoba, and it is native in Minnesota and Dakota; southward it ranges through the Mississippi Valley to Texas. In the Ohio Valley it is very common, while in the Middle Atlantic States, east of the Alleghanies, it has probably been introduced. Its existence in the Susquehanna has been known for many years. Whether it is indigenous in Pennsylvania waters is uncertain. It has been introduced into some parts of Virginia, while in other portions of that State it is native. It is indigenous in North Carolina. Its distribution in Pennsylvania has been greatly extended by artificial introduction, and it is now well established in the Delaware, especially in its upper waters. DeKay records it from Lake Champlain, the Great Lakes and the larger streams in the western counties of New York. Meek says it is a very common and well-known species in the Cayuga Lake basin. In the Passaic River and other waters it is an introduced species. Evermann and Bean obtained a specimen in Scioto Creek, Coopersville, N. Y., July 19, 1894. In the Lake Ontario region the U. S. Fish Commission collectors secured it at many localities in New York State in 1894 and previous years. The species is found in Chautauqua Lake.

Under circumstances favorable as to water and food supply the Rock Bass grows to a length of 14 inches and a weight of 2 pounds. It increases in depth and thickness with age. The largest example we have examined is one of 2 pounds weight, length 14 inches, from the James River, Va., taken near Richmond. Dr. William Overton reports that Rock Bass weighing $3\frac{3}{4}$ pounds have been taken in his vicinity at Stony Creek, Va.

In February and March this fish frequents the mouths of small streams, and in summer it seeks shady places under high banks or projecting rocks. The species is gregarious, going in large schools. It thrives where there is not much current and is very well adapted for culture in artificial ponds. It is as common in lakes and ponds as in the streams. Sluggish, pure dark water suits it best.

The fishing season begins in June and lasts till the approach of cold weather. The Rock Bass feeds on worms, crustaceans and larvæ of insects early in the season; later its food consists of Minnows and Crawfish. The young feed on insects and their larvæ. The spawning season is May and June, and gravelly shoals are resorted to for depositing the eggs.

The Rock Bass bites very freely and is a fair game fish and excellent for the table. It fights vigorously, but its endurance is not great. Suitable baits are white grubs, crickets, grasshoppers, Crawfish and small Minnows. Common earthworms are also successfully used.

100. Warmouth ; Goggle-eye (*Chænobryttus gulosus* Cuv. & Val.).

Chænobryttus gulosus JORDAN & GILBERT, Syn. Fish. N. A., 468, 1883 ; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 992, 1896, pl. CLVII, fig. 421, 1900.

The Warmouth inhabits the eastern United States from the Great Lakes to South Carolina and Texas, ranging west to Kansas and Iowa. It occurs chiefly west or south of the Alleghanies. The fish reaches a length of 10 inches and is a



WARMOUTH.

food species of some importance. It is extremely voracious and, consequently, a favorite for angling. In form and color it varies greatly.

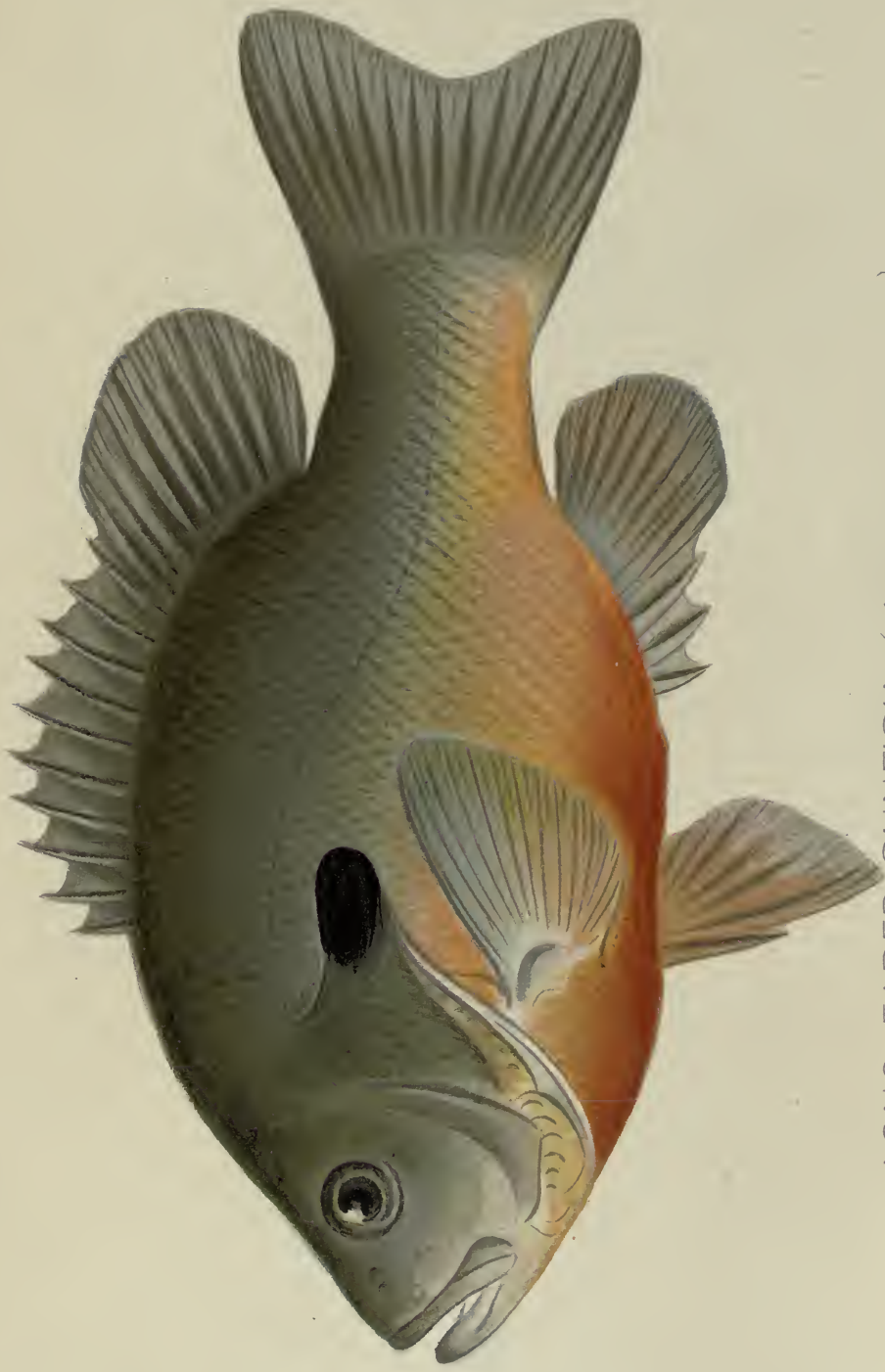
Color in life clear olive green, clouded with darker, usually without red or blue ; a dusky spot on each scale more or less distinct ; vertical fins mottled with dusky ; a faint spot on last rays of dorsal bordered by paler ; three oblique dusky bars radiating from eye ; belly yellowish.

101. Green Sunfish ; Red-eye (*Apomotis cyanellus* Rafinesque).

Lepomis cyanellus BEAN, Fishes Penna., 110, pl. 31, fig. 61, 1893 ; MEEK, Ann. N. Y. Ac. Sci., IV, 313, 1888.

Apomotis cyanellus JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 996, 1896.

The Blue-spotted Sunfish, also known as the Green Sunfish and Red-eye, extends from the Great Lakes region, throughout the Ohio and Mississippi Valleys south to



LONG EARED SUNFISH (*LEPOMIS AURITUS*).

Mexico. It does not occur in the Middle Atlantic States east of the Alleghanies. Dr. Meek did not find this fish near Ithaca. A few specimens were taken near Montezuma, N. Y. None of the collectors of the U. S. Fish Commission obtained it in the Lake Ontario region.

In spirits the color is pale brown, the fins paler. The opercular flap has a dark spot as described above. In life there is generally a black blotch on the hinder part of the dorsal and anal; the ground color is greenish with a brassy tinge on the sides, the lower parts yellowish; blue spots and gilt borders usually ornament the scales, and faint dark bands are often present. The dorsal, anal and caudal have blue or green markings, and the anal is margined in front with orange. The iris is red and the cheeks are striped with blue.

The species reaches a length of 7 inches, and is an extremely variable one. Prof. Cope refers to it as a good pan fish and states that it is abundant in the Ohio basin. In the Ohio Valley it is one of the characteristic fishes, inhabiting ponds and ascending small streams. It frequents deep holes and the shelter of overhanging roots.

102. Long-eared Sunfish (*Lepomis auritus* Linnæus).

Labrus appendix MITCHILL, Am. Month. Mag., II, 247, February, 1818.

Pomotis appendix DEKAY, N. Y. Fauna, Fishes, 32, 1842, from MITCHILL; STORER, Hist. Fish. Mass., 14, pl. III, fig. 4, 1867.

Lepomis auritus JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 477, 1883; BEAN, Fishes Penna., 113, pl. 31, fig. 63, 1893; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1001, 1896, pl. CLXIX, figs. 425, 425a, 1900; MEARNs, Bull. Am. Mus. Nat. Hist., X, 319, 1898; EUGENE SMITH, Proc. Linn. Soc. N. Y. 1897, 34, 1898.

The Long-eared Sunfish has a very extensive range and is known under many common names, among which are the following: Bream, Red-tailed Bream, Redhead Bream, Red-bellied Bream, Perch, Sun Perch, Red bellied Perch and Redbreast.

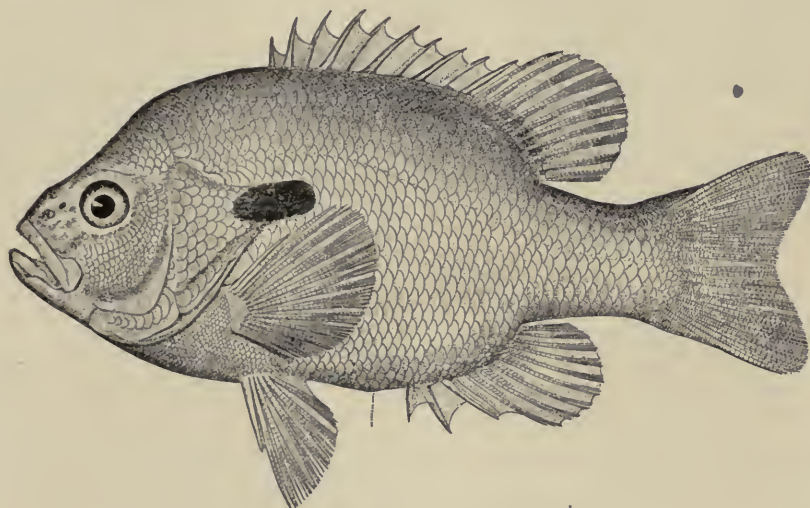
The species is common in streams east of the Alleghanies from Maine to Florida, and in tributaries of the Gulf of Mexico to Louisiana. In the Southern States the typical Long-eared Sunfish is replaced by a variety with larger scales on the cheeks and belly and a dusky blotch on the posterior part of the soft dorsal fin.

Mearns found this Sunfish abundant in the Hudson and in Poplopen's Creek, a tributary of the Hudson; he took it also in Highland Lake. Eugene Smith reported it to be very common in the upper Passaic River, in the Great Swamp and in the Bronx River.

In spirits the color is pale brown; the fins somewhat paler; the ear flap black; a brownish streak in front of the eye and another horizontal one beneath it. In life

the color is olivaceous; the belly, especially in breeding males, orange. The scales on the sides have reddish spots on a bluish ground. Dorsal, anal and caudal usually yellowish. The stripes on the head are bluish.

The Long-eared Sunfish averages about 8 inches when adult and weighs about 1 pound. In the south the size and number of individuals are greatly increased. This fish feeds on worms, insect larvæ, crustaceans, mollusks and small fishes. In the Susquehanna this is one of the most common of the Sunfishes; in the Delaware also it is abundant, and reaches a large size. Though not important commercially, it is taken in large numbers on the hook and is an excellent food fish. It takes any kind



LONG-EARED SUNFISH.

of live bait very readily and furnishes good sport also with the artificial fly. In the Hudson Highlands region, according to Mearns, it is commonly sold in the markets; fishermen take it in fykes, and by angling, using dough, grasshoppers and angleworms for bait. He has caught it in the most rapid parts of Poplopen's Creek when angling for Brook Trout.

103. Blue-gill; Blue Sunfish (*Lepomis pallidus* Mitchill).

Labrus pallidus MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 407, 1815, near New York.

Pomotis incisor CUVIER & VALENCIENNES, Hist. Nat. Poiss., VII, 466, 1831, New Orleans;

DEKAY, N. Y. Fauna, Fishes, 33, 1842 (extra limital).

Lepomis pallidus JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 479, 1883; MEEK, Ann.

N. Y. Ac. Sci., IV, 313, 1888; BEAN, Fishes Penna., 112, pl. 31, fig. 62, 1893; JOR-

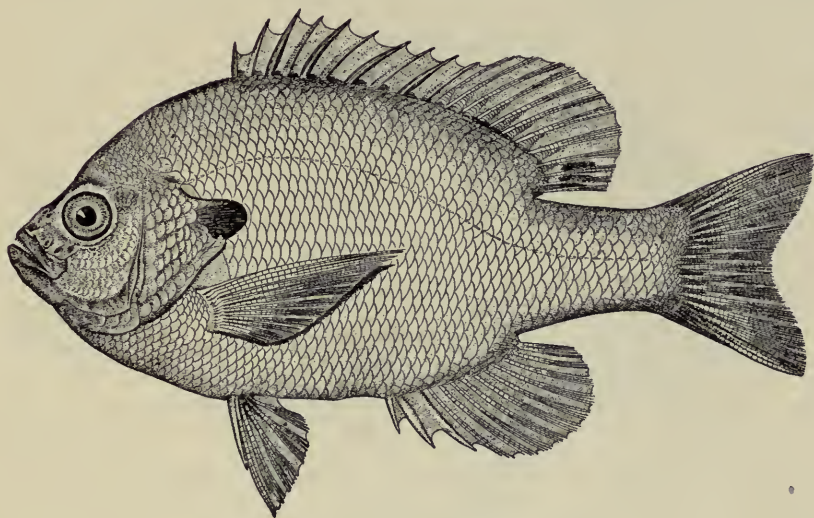
DAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1005, 1896, pl. CLX, fig. 427, 1900.

The propriety of using Mitchill's name *pallidus* for the Blue Sunfish is extremely doubtful. His description can be much more readily referred to a species of

Enneacanthus, and the locality "near New York" does not possess this Sunfish among its native species.

The Blue Sunfish, Blue Bream, Copper-nosed Bream or Dollardee is a very widely diffused species and varies greatly in size, color and length of the ear-flap. It is found in the Great Lakes and throughout the Mississippi Valley to Mexico. East of the Alleghanies it ranges from New Jersey to Florida. In Pennsylvania it is abundant only in the western part of the State, including Lake Erie. Dr. Abbott has recorded it from the Delaware River. Dr. Meek says that it is found in the Cayuga Lake basin in small numbers with the Blue Spotted Sunfish, *Apomotis cyanellus*, which he took near Montezuma. It is recorded also from Chautauqua Lake by Dr. Evermann.

The Blue Sunfish grows to a length of nearly 1 foot, and individuals weighing nearly 2 pounds are on record. Adults, however, average 8 inches in length, with a



BLUE-GILL.

weight of less than 1 pound. The size of the individuals depends on the habitat. In large lakes and streams it grows to a greater size than in small bodies of water. In southern waters it attains to a larger size than in northern waters. It lives in ponds as well as in streams and thrives in warm waters. It is considered equal to the Rock Bass as a pan fish and can very readily be taken by hook fishing.

In spirits the color is pale brown, the scales with a pale margin; a dark blotch on the hind part of the soft dorsal; a black opercular flap, its width and length about equal, shorter than the eye. The living fish varies with age from light green to dark green. The young have the sides silvery, tinged with purple and

with many vertical greenish bands, which are sometimes chain-like. The dark blotch of the soft dorsal is often indistinct in the young. In very old individuals the belly is often coppery red.

104. Sunfish; Pumpkin Seed (*Eupomotis gibbosus* Linnæus).

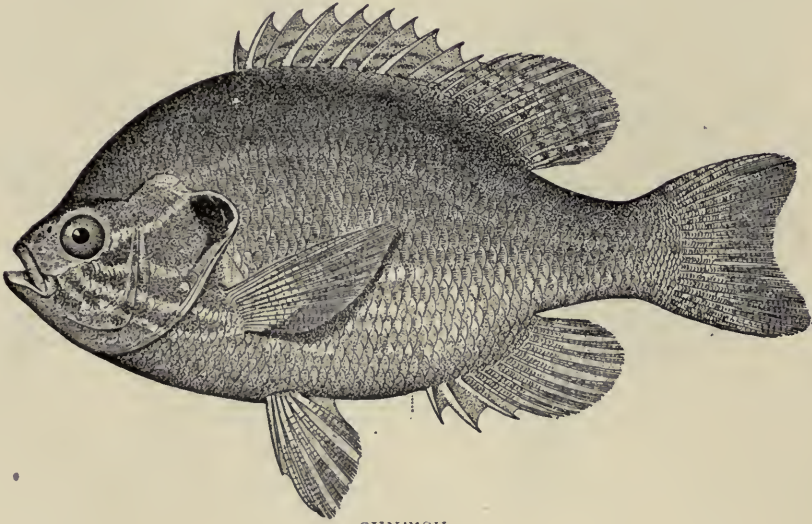
Morone maculata MITCHILL, Report in Part, 19, 1814.

Pomotis vulgaris DEKAY, N. Y. Fauna, Fishes, 31, pl. 51, 166, 1842.

Lepomis gibbosus MEEK, Ann. N. Y. Ac. Sci., IV, 313, 1888; BEAN, Fishes Penna., 115, pl. 32, fig. 65, 1893.

Eupomotis aureus MATHER, App. 12th Rept. Adirondack Surv. N. Y., 7, 1886.

Eupomotis gibbosus JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1009, 1896, pl. CLXI, fig. 429, 1900; BEAN, Bull. Am. Mus. Nat. Hist., IX, 364, 1897; MEARNs, Bull. Am. Mus. Nat. Hist., X, 320, 1898; EUGENE SMITH, Proc. Linn. Soc. N. Y. 1897, 35, 1898; BEAN, 52d Ann. Rept. N. Y. State Mus., 104, 1900.



SUNFISH.

The Common Sunfish, or Sunny, Pumpkin Seed, Bream, Tobacco Box, and Pond Fish is one of the best known fishes of the United States.

It is found from Maine westward through the Great Lakes region to Minnesota and in the Eastern States south to South Carolina. In western rivers, however, it is seldom found south of the latitude of Chicago. In New York the Sunfish abounds almost everywhere, in the lowlands as well as the highlands and in brackish as well as fresh waters; it has even been taken occasionally in salt water on Long Island. Large individuals have been received from Canandaigua Lake and from lakes in the Adirondacks. Dr. Meek found it very common throughout the Cayuga Lake basin.

The collectors of the U. S. Fish Commission obtained it in almost all the waters visited by them (21 localities) in the Lake Ontario region. Dr. Evermann has recorded it from Chautauqua Lake. It occurs in Lake Champlain and in the basin of the St. Lawrence. Eugene Smith reports it from most of the moraine ponds of Long Island and Staten Island, and in quarry ponds of the Palisades, wherein it is frequently placed by boys. Ponds and lakes in the parks of New York City are well stocked with this species. Mearns reported it as abundant in the Hudson and in all the ponds and slow streams of the Hudson Highlands. Mather recorded it as a common fish in most of the Adirondack waters, the exceptions being Piseco Lake, G Lake, Coald Lake, Seats' Lake, T Lake, Willis Pond, Murphy, Warner and Bug Lakes.

In spirits the color is pale brownish, the opercular flap black with a narrow whitish margin behind and beneath, and the dorsal fin with faint dusky blotches. In life this is one of the most brilliant of Sunfishes, the upper parts being greenish olive with a bluish tinge, the sides profusely spotted with orange, the belly and lower fins orange and the dorsal and caudal fins bluish with orange spots. The cheeks are orange with undulating blue stripes; the opercular flap is black emarginated behind and underneath with bright scarlet.

The Common Sunfish grows to a length of 8 inches and a weight of about $\frac{1}{2}$ pound. Its food is similar to that of the Long-eared Sunfish; and it is one of the readiest biters known to the angler. The habits of this fish have been described by Dr. Theodore Gill and W. P. Seal. The latter states that the male in the breeding season is readily identified by his brighter coloration, conspicuous ear flaps and a luminous border around the fins while in the water. The nest is a depression in the mud, sand or gravel, hollowed out by means of the fins. In the Potomac he found a number of nests which were located from a few inches to several feet apart. The male watches the nest and drives away all intruders. The eggs are only about $\frac{1}{32}$ of an inch in diameter and not very numerous. They are attached to stones and aquatic plants. Mr. Seal has reason to believe that the male alone is concerned in building the nest and in the care of the eggs and young.

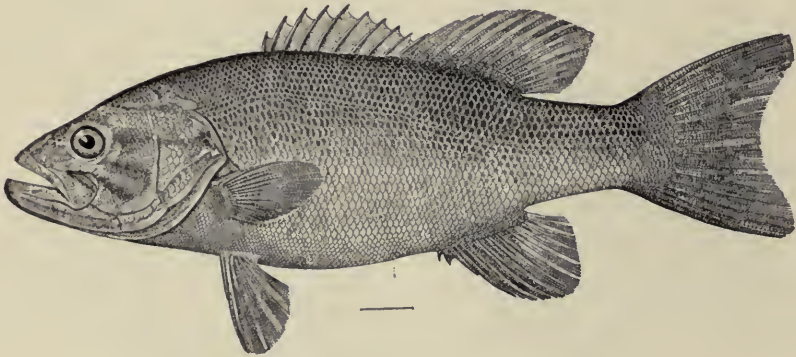
The species is usually hardy in captivity, but is subject to fungus attacks which yield readily to treatment with brackish water. In the aquarium, according to Eugene Smith, the Common Sunfish by incessant attacks often kills associates of many kinds. It is a very gamy fish, common everywhere and is usually found in the company of Shiners, Minnows and Killies. In quarry ponds, of the Palisades, says the same author, the fish will thrive and multiply as freely as the Goldfish, provided there is water enough throughout the year.

105. Small-mouthed Black Bass (*Micropterus dolomieu* Lacépède).

Micropterus dolomieu MATHER, App. 12th Rept. Adirondack Surv. N. Y., 5, 1886; MEEK, Ann. N. Y. Ac. Sci., IV, 313, 1888; BEAN, Fishes Penna., 116, color pl. 11, 1893; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1011, 1896, pl. CLXII, figs. 430, 430a, 1900; BEAN, Bull. Am. Mus. Nat. Hist., IX, 364, 1897; MEARNs, id., X, 320, 1898; EUGENE SMITH, Proc. Linn. Soc. N. Y. 1897, 35, 1898.

Centrarchus obscurus DEKAY, N. Y. Fauna, Fishes, 30, pl. 17, fig. 48, 1842, Onondaga Creek, N. Y.

One of the early names for the Small-mouthed Black Bass is that of Growler, which appears in the writings of Cuvier, who was under the impression that the name was applied because of a noise sometimes produced by this bass. At the time of his writing the name Growler was pretty generally identified with the Black Bass. Among the names applied to this fish by Rafinesque are Lake Bass, Big Bass,



SMALL-MOUTHED BLACK BASS.

Spotted Bass, and Achigan. He also mentions it under the names Painted Tail, Bridge Perch, Yellow Bass, Gold Bass, Brown Bass, Dark Bass, Minny Bass, Little Bass, Hog Bass, Yellow Perch, Black Perch, Trout Perch, Black Pearch, Streaked Head, White Trout and Brown Trout. In the Southern States the Small Mouth is known as the Trout, Perch and Jumper. In Alabama it is called Mountain Trout. Some persons style it the Bronze Backer. The most appropriate name and the one by which it is best known is that of Black Bass or Small-mouthed Black Bass.

This species is indigenous to the upper parts of the St. Lawrence basin, the Great Lakes region and the basin of the Mississippi. East of the Alleghanies it is native to the headwaters of the Ocmulgee and Chattahoochee Rivers, but north of these streams, though not originally an inhabitant of the waters, it has been widely distributed by artificial introduction.

In the St. Lawrence River Evermann and Bean obtained the fish 3 miles below

Ogdensburg, N. Y., July 17, 1894, evidently the young of the year, as the specimen is $1\frac{3}{4}$ inches long. In Scioto Creek at Coopersville, N. Y., they secured an example $1\frac{5}{8}$ inches long July 19, 1894. Field assistants of the U. S. Fish Commission, collecting in the Lake Ontario region of New York in 1894 and preceding years, took specimens in many localities.

The species is abundant in Lake Champlain and the St. Lawrence River basin; it is found also in Chautauqua Lake.

Meek did not find this species in the vicinity of Ithaca; near Cayuga and Montezuma it is less common than the Large-mouthed Black Bass. Mather reported the species in Racquette, Forked, White, Fourth, Bisby and Sucker Lakes, Black and Moose Rivers, and in Partlo Pond, St. Lawrence County, in all of which it has been introduced. The fish is not uncommon in Lake Champlain; it is abundant in the vicinity of Caledonia, N. Y. Eugene Smith records it from the Passaic River. The writer has found it abundant in the Bronx. Mearns mentions it from Long Pond, in the Hudson Highlands, where it reaches the weight of 5 or 6 pounds.

This Bass does not grow so large as the Large-mouthed, seldom exceeding 8 pounds in weight and averaging but $2\frac{1}{2}$ pounds. A fish of the latter weight will measure 15 inches in length, while one of 8 pounds will measure 2 feet.

The Small-mouthed Bass differs most markedly from the Large-mouthed in the size of its jaws, the shallower notch in the dorsal fin and the smaller scales. There are about 11 rows of scales above the lateral line and 7 below it; 72-74 scales in the lateral line.

The young are dull yellowish green, the sides mottled with darker spots, which sometimes form short vertical bars. Three dark stripes on the head; caudal yellowish at the base; a broad black band near middle of tail and a broad whitish margin behind. The dark lateral band characteristic of the Large-mouthed species is not found in the Small-mouth. In the adult the prevailing color is olive green, the stripes on the head remaining more or less distinct.

The food of the Black Bass consists of Crawfish, frogs, insects and their larvæ, Minnows, and other aquatic animals of suitable size. The young can be fed on small fresh-water crustaceans, such as Daphnia and Cyclops. Among the successful baits for this species are Stone Catfish, Hellgramites and crickets.

The Black Bass prefers rapid water, is extremely active, and frequents clear, pure, swiftly-flowing streams, and thrives at greater elevations than those preferred by the Large-mouthed species. It hibernates in the winter and spawns in the shallows on gravelly bottoms in spring. It follows its prey into shallow water and frequently leaps far out of the water in its efforts to escape from the hook or when frightened

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by the sudden approach of an enemy. It swims in schools and is often found in the shelter of sunken logs and in the vicinity of large rocks.

The spawning season begins in March and ends in July. The period of incubation lasts from 7 to 14 days. The eggs are bound together in bands or ribbons by an adhesive substance. They adhere to stones on which they are deposited. The parent fish build nests and protect the eggs and young. In the Delaware the current is more rapid and the temperature lower than in the Susquehanna; hence the Bass spawn earlier in the latter than in the former. The spawning fish have nearly all left their spawning beds in the Susquehanna early in July, but at this time most of the nests in the Delaware are still full of eggs. By some writers it is believed that the female prepares the nest before the male joins her. The males fight for the possession of the female and are said to help the process of ejecting the eggs by biting or pressing the belly of the female. After the eggs are deposited, the female guards the nest from the attacks of the Crawfish and some other fishes. The young are consumed by many birds and by frogs and snakes. Yet, notwithstanding the numerous enemies of the Black Bass, its multiplication has been rapid and enormous.

The Small-mouthed Black Bass ceases to take food on the approach of cold weather and remains nearly dormant through the winter, except in artificially heated water. A number of the young of the year, received from James Annin, Jr., of Caledonia, N. Y., October 6, 1896, scarcely fed at all in the following winter, but when the spring was advanced they fed eagerly and grew rapidly.

106. Large-mouthed Black Bass (*Micropterus salmoides* Lacépède).

Huro nigricans DEKAY, N. Y. Fauna, Fishes, 15, pl. 69, fig. 224, 1842.

Micropterus salmoides MEEK, Ann. N. Y. Ac. Sci., IV, 313, 1888; BEAN, Fishes Penna., 118, pl. 32, fig. 66, 1893; Bull. Am. Mus. Nat. Hist., IX, 364, 1897; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 1012, 1896, pl. CLXIII, fig. 431, 1900; MEARNS, Bull. Am. Mus. Nat. Hist., X, 320, 1898; EUGENE SMITH, Proc. Linn. Soc. N. Y. 1897, 36, 1898; BEAN, 52d Ann. Rept. N. Y. State Mus., 105, 1900.

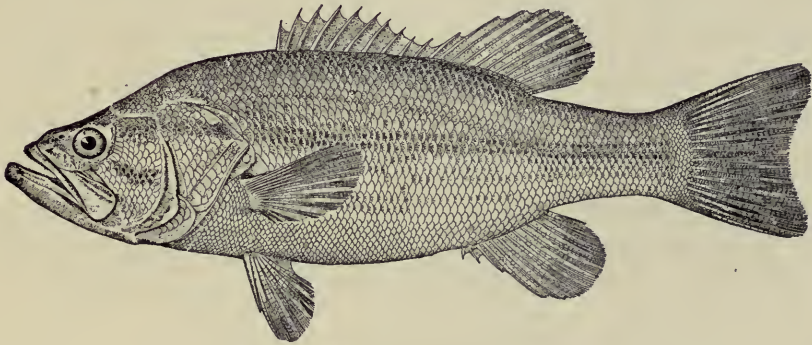
This species may best be distinguished from the Small-mouthed Black Bass by the size of its mouth and the number of rows of scales above the lateral line. The young of the Small-mouthed species, also, never have a dark, lateral band.

Common names for this species are: Oswego Bass, River Bass, Green Bass, Moss Bass, Bayou Bass, Trout, Jumper, Chub and Welshman. Throughout the north it is generally known as Bass, in Virginia and North Carolina as Chub and in Florida and west to Texas as Trout.

The Large-mouthed Bass has a wide distribution, being indigenous to the eastern United States, from Manitoba to Florida and Texas, except New England and the Middle Atlantic States east of the Alleghanies, where it has been extensively introduced. It inhabits the fresh-water ponds, lakes and sluggish streams. It is found also at the mouths of rivers emptying into the Gulf of Mexico, where the water is brackish.

Dr. Meek found the Large-mouthed species scarce near Ithaca and more common near Montezuma and Cayuga. James Annin, Jr., collected the young at Caledonia. The U. S. Fish Commission had it from numerous places in the Lake Ontario region.

Dr. Mearns first observed the species in the Hudson in the autumn of 1882, where the fish were caught in fyke nets during October and November. Eugene Smith records it from all lakes and rivers adjacent to New York City.



LARGE-MOUTHED BLACK BASS.

Young individuals, from $1\frac{1}{2}$ to 2 inches long, were seined in Bronx River in August, 1897.

The average weight of the Large-mouthed Bass in southern waters is less than 5 pounds, and still less in northern waters. In Florida it attains a large size, as much as 3 feet in length, and a weight of 25 pounds. Its growth and size depend on the waters where it is found, and the natural food supply of small fish, Crawfish and frogs.

It is a very active fish; its movements are affected by seasonal changes and the search for food and places for spawning. In polluted streams the Bass are often compelled by the impurities to seek new haunts in pure water. The young Bass feed on animal food at an early age. The Large-mouthed Bass is said to be more cannibalistic than the Small-mouthed. Small fishes (Minnows) of all kinds, Crawfish, frogs, insects and their larvæ, and aquatic animals of all kinds, suitable in size, make up the diet of this fish. It feeds both at the surface and on the bottom, pursuing its prey with great activity. When surrounded by seines or caught on hooks this

species will often leap 5 or 6 feet out of the water, and its habit of jumping over the cork lines of seines has given it the name of "Jumper."

In cold weather the Bass seeks deep places, often hibernating under rocks, sunken logs and in the mud. Favorite localities are under overhanging and brush-covered banks, in the summer, and among aquatic plants, where the fish lies in wait for its prey.

The spawning season of the Large-mouthed Bass is about the same as that of the Small-mouthed species, beginning in April and lasting till July. Its eggs are adhesive, sticking to stones during the incubation period, which last from one to two weeks according to the temperature of the water. The young Bass remain in the nest a week or 10 days, and at the age of two weeks will measure about $\frac{3}{4}$ of an inch in length. In suitable waters it is estimated that the Large-mouthed Bass will weigh at the age of three years from 2 pounds to 4 pounds.

The Oswego Bass is even more destructive to fish than *M. dolomieu*. It will eat any fish which it can manage to get into its mouth and will lie on the bottom for days so gorged that it cannot stir. In voracity it is only equaled, but hardly excelled by the Pike. This Bass bears captivity well. (After Eugene Smith.*)

The young above referred to as coming from Caledonia, N. Y., hibernated and took scarcely any food during the winter, but fed ravenously in spring, summer, and fall. They proved very hardy in captivity.

107. Pike Perch; Pike; Wall-eyed Pike (*Stizostedion vitreum* Mitchill).

Pérca vitrea MITCHILL, Am. Month. Mag., II, 247, Feb. 1818, Cayuga Lake, N. Y.

Lucioperca americana DEKAY, N. Y. Fauna, Fishes, 17, pl. 50, fig. 163, 1842.

Lucioperca vitrea EUGENE SMITH, Proc. Linn. Soc. N. Y. 1897, 38, 1898.

Stizostedion vitreum MEEK, Ann. N. Y. Ac. Sci., IV, 314, 1888; BEAN, Fishes Penna., 127, color pl. 13, 1893; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1021, 1896, pl. CLXIV, fig. 433, 1900; BEAN, Bull. Am. Mus. Nat. Hist., IX, 364, 1897.

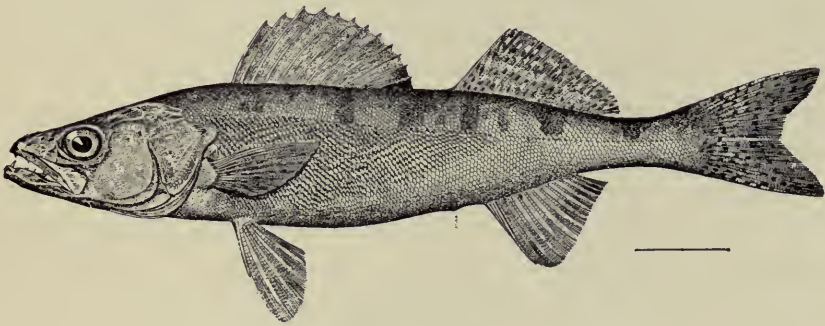
The Pike Perch belongs to the genus *Stizostedion*, which has been distinguished from the Saugers by the structure of its pyloric cæca, which are three in number, nearly equal in size, and about as long as the stomach, and also by the presence of 21 soft rays in the second dorsal, while the Saugers have 18. It may be remarked that all of these characters are more or less variable.

The Pike Perch has received a great many common names. One of the most unsuitable is "Susquehanna Salmon," which is used in Pennsylvania. In the Eastern

* Proc. Linn. Soc. N. Y. No. 9, p. 36, 1897.

States the species is styled the Perch Pike or the Pike Perch, Glasseye and Wall-eyed Pike. In the Great Lakes region it is known as Blue Pike, Yellow Pike, Green Pike and Grass Pike. In the Ohio Valley and Western North Carolina it is the Jack; in Lake Erie and Canada, the Pickerel; in some parts of the Ohio Valley, the White Salmon or Jack Salmon. The Cree Indians call it the *okow* and the French Canadians *doré* or *picarel*. Among the fur traders of British America it is called the Hornfish.

The Pike Perch or Wall-eyed Pike inhabits the Great Lakes region and extends northward into British America, where it has been recorded as far as 58° north by Dr. Richardson. It ranges south in the Mississippi Valley to Arkansas, and in Atlantic streams to Georgia. According to Dr. Meek the species is found in Cayuga Lake, but is not common. In Lake Champlain it is one of the principal game fishes. James Annin, Jr., of Caledonia, obtained specimens in the Canandaigua Lake region. It has been introduced into numerous lakes by the Fisheries, Game and Forest Com-



PIKE PERCH.

mission of New York. The U. S. Fish Commission secured examples in the Oswego River at Oswego and at Point Breeze in August, 1894.

This species is said to reach a weight of 50 pounds, but the average weight of the market specimens is less than 5 pounds. In the Susquehanna it occasionally reaches 10 pounds or upward in weight. The Pike Perch feeds on the bottom on other fishes, and has been charged even with destroying its own young. It prefers clear and rapid waters, and lurks under submerged logs and rocks, from which it can readily dart on its prey. Spawning takes place in April and May, and in Pennsylvania continues till June. Favorite spawning localities are on sandy bars in shallow water. The period of hatching varies from about 14 to 30 days, depending on the temperature of the water. The eggs vary from about 17 to 25 to the inch, and a single female has been estimated to contain from 200,000 to 300,000. In a state of nature only a small percentage of the eggs are hatched out; the greater proportion

are driven on the lake shores by storms or devoured by fishes on the spawning beds. The number of Pike Perch annually hatched by artificial methods is enormous. This advance is due to improvements in the treatment of adhesive eggs. Formerly these were hatched by placing them on glass plates, to which they readily adhere. Recently it has been found that the sticky substance can be washed off the eggs, after which they are placed in jars and hatched like eggs of the Shad and Whitefish.

"Dexter," in *Forest and Stream*, August 14, 1890, makes the following statement about the habits of this species in the lakes. These fish run up the rivers before or as soon as the ice is out, and after spawning lie off the rivers' mouth feeding on and off the sand flats, as the spring rains bring down plenty of worms, and probably other matter which they feed on. As soon as the water gets warm, they sag off and work along the shores in 10 to 30 feet of water, preferring cobbly bottom; from here they go into very deep water, coming on the reefs to feed, and when the wind blows very hard, or for a day or so after a big blow, you will find them right on top of a reef. I think the wind changes the water over the reefs, making a new current and cooler water, so they come up to feed. They are a bottom fish, and to fish for them successfully one must go to the bottom for them. They are nearly as particular as Salmon Trout about the water they inhabit and consequently rank very high as a food fish, being white, solid and extremely free from bones.

Color olivaceous, mingled with brassy; sides of the head vermiculated; the dorsals, caudal and pectoral with bands; those of the dorsals and caudal not continuous; sides with about seven oblique dark bands, differing in direction; a jet black blotch on the membrane behind the last spine of the dorsal.

The colors of the Pike Perch change remarkably with age. The young have oblique dark bands much like those of the Kingfish of our east coast, and bear little resemblance in the pattern of coloration to the parent. The eye of the living fish is like a glowing emerald. The rate of growth must be rapid. In July, 1888, we took examples from 4 to 6 inches long, some of which seemed to be the young of the year.

This is one of the finest food and game fishes of the United States. Its flesh is firm and white, flaky and well flavored. Commercially the species ranks high in the Great Lakes region, being next in importance to the Whitefish. In angling for the Pike Perch live Minnows are used in preference to all other baits, particularly such as are more or less transparent and with silvery sides, as the Fallfish or Dace, the Corporal Roach, the Redfin and the Gudgeon. On some parts of the Susquehanna, between Columbia and Harrisburg, the favorite mode of capture is by trolling with the spoon with the same kind of tackle as is used for the Black Bass.

In November of 1896 and 1897, Mr. Annin shipped adult individuals from Canandaigua Lake by express without an attendant, and there was scarcely any loss of fish in transportation, though the journey lasts 12 hours.

The Blue Pike of Lake Erie, or White Salmon of the Ohio River, was formerly distinguished by name from the common Pike Perch, but is now considered unworthy of a separate name. This is a very small variety seldom exceeding 15 inches in length and a weight of 2 pounds. The dorsal has 14 spines and 20 rays. The spines are rather lower than in the Pike Perch, the coloration similar, but the adult is bluish or greenish and has no brassy mottling. The fins are darker, and there is a trace of a band along the dorsal, besides the black blotch on the hind portion.

Jordan & Evermann say of this variety: "The name *salmoncum* has been applied to the so-called 'Blue Pike' originally described from the Ohio River, but more common in the Great Lakes, particularly Ontario and Erie. It is smaller and deeper in body than the ordinary *vitreum* and different in color, but it is not likely that any permanent distinctions exist, this species, as usual among fresh-water fishes, varying largely with the environment and with age."

108. Sauger ; Sand-Pike (*Stizostedion canadense* Smith).

Lucioperca canadensis DEKAY, N. Y. Fauna, Fishes, 19, pl. 68, fig. 221, 1842 (extra-limital).

Stizostedion canadense MEEK, Ann. N. Y. Ac. Sci., IV, 314, 1888 ; BEAN, Fishes Penna., 130, pl. 34, fig. 70, 1893 ; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1022, 1896, pl. CLXIV, fig. 434, 1900.

Color olivaceous above ; sides brassy or pale orange, mottled with black in the form of irregular dark blotches, which are best defined under the soft dorsal. The spinous dorsal has several rows of round black spots on the membrane between the spines ; no black blotch on the hind part of the spinous dorsal. Pectorals with a large dark blotch at base ; soft dorsal with several rows of dark spots irregularly placed ; caudal yellowish with dark spots forming interrupted bars.

The Sauger is known also as Sand Pike, Gray Pike and Green Pike, Pickering, Pickerel and Horse Fish. It is found in the St. Lawrence River and Great Lakes region, the upper Mississippi and Missouri Rivers and in the Ohio, where it is said to have been introduced from the lakes through canals. This is a small fish, seldom exceeding 18 inches in length, and embraces several varieties. It is very common in the Great Lakes and is abundant in the Ohio River. It is doubtful whether it is native to Ohio or introduced. It is also found rarely in Cayuga Lake.

Rev. Zadock Thompson, in his *History of Vermont*, says it is much less common in Lake Champlain than the Pike Perch, but is frequently taken in company with it. It usually swims very near the bottom of the water, and hence it has received the name of Ground Pike (Pike Perch). As an article of food this species is locally held in the same high esteem as the common Pike Perch.

John W. Titcomb of St. Johnsbury, Vt., informed Evermann and Kendall that the Sauger, or Rock Pike, as it is locally called, is caught in seines while fishing for the Pike Perch. It does not grow as large as the latter, and is not much valued as a food fish. The authors mentioned received two examples of the fish from A. L. Collins, of Swanton, Vt., one of them a nearly ripe female $14\frac{1}{2}$ inches long, weighing three-fourths of a pound, the other an unripe male 15 inches long, weighing three-fourths of a pound. These specimens were believed to indicate that the Sauger spawns earlier than the Pike Perch. The stomach of the male contained a three-inch Minnow, too badly digested for identification, and a number of small insects.

It is very extensively used for food, but is not generally considered equal to the Pike Perch.

109. Gray Pike ; Sauger ; Sand Pike (*Stizostedion canadense griseum* DeKay).

Lucioperca grisea DEKAY, N. Y. Fauna, Fishes, 19, 1842, Great Lakes; streams and inland lakes of Western New York.

Stizostedion canadense griseum JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1022, 1896.

This is the common Sand Pike or Sauger of the Great Lakes region and southwestward. It differs from the typical *canadense* chiefly in the smoother opercles and head bones, the fewer opercular spines, and the less complete scaling of the head. The two need fuller comparison and may prove to be distinct species, but this is unlikely. Length, 10 to 18 inches.

110. Yellow Perch; Ring Perch (*Perca flavescens* Mitchill).

Morone flavescens MITCHILL, Report in Part, 18, 1814.

Bodianus flavescens MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 421, 1815.

Perca serrato-granulata DEKAY, N. Y. Fauna, Fishes, 5, pl. 22, fig. 64, 1842

Perca granulata DEKAY, op. cit. 5, pl. 68, fig. 220, 1842.

Perca acuta DEKAY, op. cit. 6, pl. 68, fig. 222, 1842.

Perca gracilis DEKAY, op. cit. 6, 1842.

Perca flavescens DEKAY, op. cit. 3, pl. 1, fig. 1, 1842; MEEK, Ann. N. Y. Ac. Sci., IV, 314, 1888; BEAN, Fishes Penna., 126, color pl. 12, 1893; EVERMANN & KENDALL, Rept. U. S. F. C. for 1894, 602, 1896; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1023, 1896, pl. CLXV, fig. 435, 1900; BEAN, Bull. Am. Mus. Nat. Hist., IX, 365, 1897; MEARN, Bull. Am. Mus. Nat. Hist., X, 320, 1898; EUGENE SMITH, Proc. Linn. Soc. N. Y. 1897, 37, 1898.



YELLOW PERCH.

The Yellow Perch, Ringed Perch, or Striped Perch is found throughout the Great Lakes region, rivers and ponds of New England and northwestward, and in streams east of the Alleghanies south to Georgia. It does not occur in the Ohio Valley or southwest, though, after the construction of the Ohio Canal, Kirtland recorded it from the Ohio River. In 1790 Dr. Mitchill transferred some of them from Ronkonkoma to Success Pond, a distance of 40 miles, where they soon multiplied. In 1825 Yellow Perch were transported from Skaneateles to Otisco Lake and Onondaga Lake; in the latter they increased remarkably. In Otsego Lake DeKay caught some weighing nearly 3 pounds. Meek states that the species is common throughout the Cayuga Lake basin. Evermann and Bean took it in the St. Lawrence River, 3 miles below Ogdensburg; also in Scioto Creek, Coopersville, N. Y., July 19, 1894, young specimens $1\frac{1}{2}$ to $1\frac{3}{4}$ inches long.

The Yellow Perch is one of the most abundant fishes of Lake Champlain and in the mouths of rivers falling into that lake.

The fish abounds in the parks of New York and Brooklyn. In the Hudson Highlands Dr. Mearns reported it as abundant in the Hudson as well as in all of the larger mountain lakes and ponds. It habitually frequents Poplopen's Creek from its source to its mouth. In the Hudson, he was informed, it is unusual to take specimens weighing more than 1 pound; but in Poplopen's Pond he has taken a number that weighed about 2 pounds each. In the same pond Jerome Denna caught two which weighed $2\frac{1}{2}$ to 3 pounds each; and a fisherman named Samuel Runnels assured Dr. Mearns that he had taken a Yellow Perch there which weighed $4\frac{1}{4}$ pounds. The fish continue to feed in that region throughout the winter. Eugene Smith obtained the fish in Greenwood Lake, Orange County, and in Hackensack streams, in Rockland County.

The species reaches a length of 1 foot and weight of 2 pounds. It is one of the best known of our food fishes and has excellent game qualities. Its flesh, however, is rather soft and coarse and is far inferior to that of the Black Bass and other members of the Sunfish family. It is a voracious feeder, its food consisting of small fishes, crustaceans and other animal matter.

The Yellow Perch spawns early in the spring. The eggs are adhesive and enclosed in thin translucent strips of adhesive mucus. The spawning of this species was described by William P. Seal in *Forest and Stream* of April 17, 1890. The spawning season extends from December to April. Mr. Seal describes the egg mass as having the shape of a long tube, closed at the ends and arranged in folds like the bellows of an accordion. When folded the mass was about 8 to 12 inches long, but was capable of being drawn out to a length of 3 or 4 feet. Spawning in the aquarium took place at night and was observed by William Maynard, who describes it as follows: "The female remained quiet in one spot on the bottom of one of the hatching aquaria tanks, one or more of the males hovering over and about her with pectoral fins vibrating with intense activity. The males would at times lie close alongside of her and at other times endeavor to force themselves under her with the evident intention of assisting in the extrusion of the eggs." Mr. Seal remarks that "the roe when taken from the dead fish not yet ripe is in a single compact mass, covered by a thin membrane; but in spawning the mass separates, one side being spawned before the other." This was noticed in a specimen which had spawned one side and appeared to be unable to get rid of the other. It was stripped from her and artificially fertilized successfully. Mr. Seal believes that the Yellow Perch spawns at the age of one year.

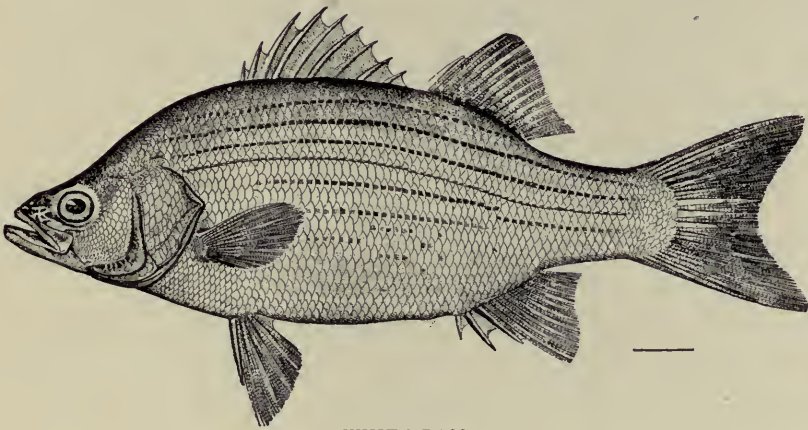
The Yellow Perch thrives moderately in captivity, though susceptible to attacks of fungus, which are easily overcome by the use of brackish water.

III. White Bass (*Roccus chrysops* Rafinesque).

Labrax albidus DEKAY, N. Y. Fauna, Fishes, 13, pl. 51, fig. 165, 1842, Buffalo.

Roccus chrysops BEAN, Fishes Penna., 132, pl. 34, fig. 71, 1893; Bull. Am. Mus. Nat. Hist., IX, 365, 1897; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1132, 1896, pl. CLXXX, fig. 477, 1900; EUGENE SMITH, Proc. Linn. Soc. N. Y., 1897, 38, 1898.

General color silvery, tinged with golden on sides; eight or more blackish longitudinal streaks on sides, those below more or less interrupted.



WHITE BASS.

The following measurements were taken from a specimen obtained by Mr. James Annin, Jr., in Oneida Lake, September 4, 1896:

	INCHES.
Extreme length, - - - - -	12 $\frac{1}{4}$
Length to end of middle caudal rays, - - - - -	11 $\frac{1}{2}$
Length to end of scales, - - - - -	10
Depth of body, - - - - -	4
Least depth of caudal peduncle, - - - - -	1 $\frac{3}{8}$
Length of head, - - - - -	3
Length of snout, - - - - -	$\frac{5}{8}$
Diameter of eye, - - - - -	$\frac{9}{16}$
Length of fourth dorsal spine, - - - - -	1 $\frac{3}{8}$
Length of second dorsal ray, - - - - -	1 $\frac{3}{4}$
Length of second anal ray, - - - - -	1 $\frac{3}{4}$
Weight, 16 $\frac{1}{2}$ ounces.	

The White Bass is sometimes called Striped Bass, and is probably the Silver Bass of Canada. Its center of abundance is the Great Lakes region, but it is also widely distributed over the Ohio and Mississippi Valleys. In Pennsylvania the species is found in Lake Erie and in the tributaries of the Ohio River. The U. S. Fish Commission secured three specimens at Horse Island, Sackett's Harbor, N. Y., June 30. The New Jersey Fish Commission has introduced the fish into Greenwood Lake.

The White Bass weighs from 1 to 3 pounds, and its flesh is considered almost if not equally as good as that of the Black Bass. It prefers the deeper parts of rivers and thrives best in lakes and ponds. In April and May they leave the deeper waters and go in near shore or to the mouths of rivers where they spawn. The spawning period is in May and June.

The White Bass feeds upon Minnows, Crawfish and other fresh-water crustaceans, also minute mollusks or shellfish, and it is said to devour many young Whitefish upon the spawning grounds of that species.

It is a game fish and affords good sport to the angler.

112. Striped Bass; Rock fish (*Roccus lineatus* Bloch).

Roccus striatus MITCHILL, Rept. Fish. N. Y. 25, 1814.

Perca mitchilli MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 413, pl. III, fig. 4, 1815.

Perca mitchilli alternata MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 415, 1815.

Perca mitchilli interrupta MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 415, 1815.

Labrax lineatus DEKAY, N. Y. Fauna, Fishes, 7, pl. 1, fig. 3, 1842.

Roccus lineatus BEAN, 19th Rept. Comm. Fish. N. Y., 267, pl. XVIII, fig. 22, 1890; Fishes Penna., 131, color pl. 14, 1893; Bull. Am. Mus. Nat. Hist., IX, 365, 1897; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1132, 1896, pl. CLXXX, fig. 478, 1900; EUGENE SMITH, Proc. Linn. Soc. N. Y. 1897, 38, 1898; MEARNs, Bull. Am. Mus. Nat. Hist., X, 321, 1898; H. M. SMITH, Bull. U. S. F. C. for 1897, 99, 1898; BEAN, 52d Ann. Rept. N. Y. State Mus., 105, 1900.

Sides greenish above, silvery below, sometimes with a brassy lustre and marked by seven or eight longitudinal streaks none of which are half as wide as the eye, one of them passing along the lateral line; the lowermost stripe is somewhat below the middle of the depth.

In the southern United States from New Jersey to Florida the Striped Bass is known as the Rock or Rockfish. In the Northern States the name Striped Bass is more generally used than the other, especially along the coast. In the Delaware, Susquehanna and Potomac Rivers it is called Rockfish. Green Head and Squid

Hound are names applied to large individuals found in the sea in New England waters. One of the old names of the fish is Streaked Bass.

Rock fish and Striped Bass, according to Schoepff (1787), are among the early New York names for this highly prized species. Dr. Mitchill (1814) calls it Mitchill's Perch, Striped Basse and Rock fish. DeKay describes it as the Striped Sea Bass. Streaked Bass is another name in use in 1815, and a very interesting account of the fish under this name is published by Dr. James Mease in the first volume of the *Transactions of the Literary and Philosophical Society of New York*. Dr. Mease in this article states that Rock fish weighing from 25 pounds to 60 pounds are called Green-heads. At the time of his writing, the fishing ground for the Philadelphia and New York markets was between Long Branch and Cranberry Inlet, an extent of about thirty miles, and the great places of winter resort were Motetecunk, 30 miles from Long Branch, and the rivers of Elk and Egg Harbor.



STRIPED BASS.

The range of the Striped Bass or Rockfish includes the entire Atlantic coast from the Gulf of St. Lawrence to the Gulf of Mexico, the fish entering rivers and ascending them long distances. In the Alabama River this fish is known to be taken every year and some large individuals have been obtained from that stream. It has been captured also in the lower Mississippi. It is very abundant in the great bays and sounds from North Carolina to Cape Cod. In Albermarle Sound many large individuals are said to occur. In the St. John's River, Florida, according to Dr. Goode, the fish is rather rare. In the vicinity of Pensacola the late Silas Stearns occasionally obtained a specimen of the fish.

The Striped Bass has been introduced into California and has now become fairly acclimated there. In the Delaware and Susquehanna Rivers this is one of the common fishes and it is one of the most highly esteemed.

This is a permanent resident of Gravesend Bay, but the height of the fishery occurs from October 10 to November 10. Large fish, up to 45 pounds, are caught

in May, but the fall fish range from 9 inches to 24 inches in length. In Great South Bay the writer has obtained specimens at Blue Point Cove, Great River, Nichols's Point, and off Widow's Creek. A great haul was made on Lone Hill Middleground about the middle of October, 1901. The fish remains in some of the tributaries of Great South Bay throughout the year. According to Dr. Mearns the species is taken in great numbers in nets set through the ice of the Hudson in winter, and in drift nets by shad fishermen in spring. Large individuals of 60 pounds and upward are sometimes caught in the winter and early spring. He once took a specimen a little above the estuary of Poplopen's Creek, in fresh water.

At the time of Dr. Mitchell's report the greatest run occurred late in the fall, and the great hauls were made during the coldest season, including some very large fish. He saw, however, a dozen at a time weighing 50 pounds each in New York market during very mild weather, in early October.

This fish lives in the sea or in brackish or fresh water indifferently and it has been successfully kept in artificial ponds. In cold, northern waters it becomes ice bound occasionally and is said to hibernate. It prefers cold water, is carnivorous and predaceous, feeding upon small fishes in the streams, consuming especially large quantities of the Alewife or River Herring and the young of the Shad. In the shallow bays along the coasts its food consists of Killifish, Silversides, Anchovies, Lant and other small fishes, besides crabs, squid, clams, mussels and other marine invertebrates. Its movements while feeding depend greatly upon the tides. It is to be found frequently at the mouths of small creeks and in tideways, where it lies in wait for the large schools of small fishes, which constitute its food.

The largest Striped Bass recorded was said to weigh 112 pounds. At Avoca, North Carolina, Dr. Capehart took a Striped Bass weighing 95 pounds. It reaches a length of $4\frac{1}{2}$ or 5 feet.

Spawning takes place from April to June, either in the rivers or in the brackish waters of bays and sounds. Eggs have been hatched artificially in May on Albermarle Sound. Dr. Capehart took a 58-pound spawning fish April 22, 1891. The eggs are smaller than those of the Shad, and after fertilization they increase greatly in size and become light green in color. This 58-pound fish probably contained more than one-half million eggs. Dr. Abbott has found the young an inch long in the Delaware the second week in June, and by the middle of October some of these had grown to a length of $4\frac{1}{2}$ inches. The Striped Bass has been kept in a small pool of fresh water and fed upon crabs and oysters, increasing in about eleven months from 6 inches in length to 20 inches. In the aquarium the species is hardy and grows rapidly; it can be kept in good condition almost indefinitely. In a Rhode Island

pond it is stated that Bass weighing $\frac{1}{2}$ pound to 1 pound in June had reached a weight of 6 pounds in the following October.

In fresh water, salted eel tail is a favorite bait for taking Striped Bass, and the spoon or spinner is also a good lure, but live Minnows are preferred to all other baits. For surf fishing shedder crab well fastened to the hook is a very killing bait.

113. White Perch (*Morone americana* Gmelin).

Morone rufa MITCHILL, Rept. Fish. N. Y., 18, 1814, New York.

Morone pallida MITCHILL, Rept. Fish. N. Y., 18, 1814, New York.

Bodianus rufus MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 420, 1815.

Labrax rufus DEKAY, N. Y. Fauna, Fishes, 9, pl. 3, fig. 7, 1842.

Labrax pallidus DEKAY, N. Y. Fauna, Fishes, 11, pl. 1, fig. 2, 1842.

Labrax nigricans DEKAY, N. Y. Fauna, Fishes, 12, pl. 50, fig. 160, 1842.

Roccus americanus BEAN, 19th Rept. Comm. Fish. N. Y., 268, pl. XIX, fig. 23, 1890.

Morone americana BEAN, Fishes Penna., 133, pl. 15, 1893; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1134, 1896, pl. CLXXXI, fig. 479, 1900; BEAN, Bull. Am. Mus. Nat. Hist., IX, 366, 1897; MEARNs, Bull. Am. Mus. Nat. Hist., X, 321, 1898; EUGENE SMITH, Proc. Linn. Soc. N. Y., 1897, 39, 1898; H. M. SMITH, Bull. U. S. F. C., 1897, 99, 1898; BEAN, 52d Ann. Rept. N. Y. State Mus., 105, 1900.

This is the Perch or River Perch of Schoepff, which he records as an inhabitant of the coasts of New York and Long Island, in and at the mouths of fresh-water streams. Dr. Mitchill (1815) gives it the name of Red Perch, and states that when not in the breeding season it is called Black Perch because its colors are browner and darker. DeKay describes it, in the *Fishes of New York*, as the Ruddy Bass. In Great Egg Harbor Bay individuals taken from salt water are sometimes called Yellow Perch or Peerch.

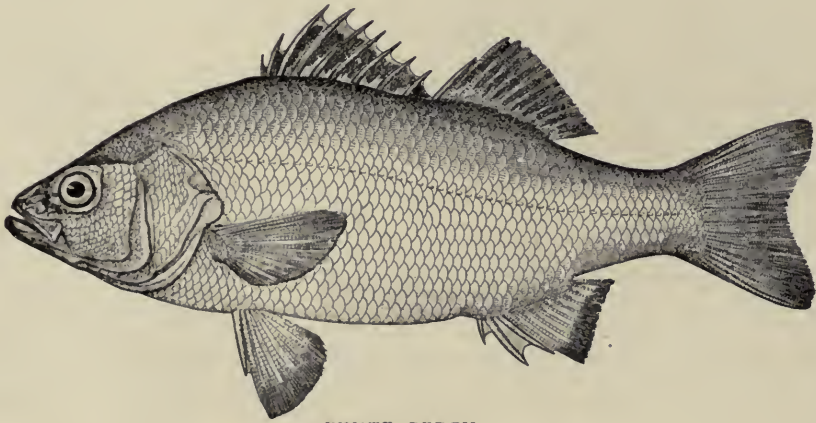
The species is found from Nova Scotia to South Carolina, and inhabits both salt and fresh water. Mitchill saw specimens 14 inches long and nearly 5 inches deep, from Quag, Long Island. There is an important winter fishery for the White Perch at Bellport. It is taken in seines and gill nets. The writer has occasionally found this species in various parts of Great South Bay, for example, at Smith's Point, Whale House Hole, Swan River, also in the east end of Shinnecock Bay, in the fresh water of Head of Creek, near Southampton. The fishermen affirm that when its feeding grounds are disturbed by seining the fish suddenly leave the locality. The White Perch is never plentiful in Gravesend Bay; it is abundant in fresh-water lakes of Central Park, New York, and Prospect Park, Brooklyn. Near Montauk, Long Island, the species is abundant and reaches a large size. Eugene Smith has

found it common in brackish waters near New York, where it occurs all the year; he had it also from fresh water. Mearns states that it remains in the Hudson throughout the year and is taken in abundance in winter in nets set through the ice. In Oscawana Lake, Putnam County, individuals weighing 2 or 3 pounds were reported to him.

In the vicinity of Woods Hole, Mass., the fish is abundant in fresh-water ponds connected with salt water.

It is said that the White Perch formerly extended south to Florida and the Gulf of Mexico, but this is discredited by competent observers. The Perch of Lake Ponchartrain is very likely the species now known in many portions of the Western States as the Fresh-water Drum, *Aplodinotus grunniens*.

The average length of the White Perch is about 9 inches and its weight $\frac{1}{2}$ pound or less, but numerous specimens measuring 14 inches and weighing 2 pounds or more have been taken, especially in New England waters.



WHITE PERCH.

At the time of Dr. Mitchill's writing the species was a favorite in New York markets, and it is now one of the best known species although probably not ranking among the choicest kinds.

Thad. Norris was one of the most earnest supporters of the White Perch, and has published interesting observations concerning its habits. Comparatively little, however, is known about its life. It is an associate of the Striped Bass, and, according to Dr. Abbott, resembles this species in its feeding habits. It differs from the Striped Bass in its tendency to seek warm waters.

The White Perch is a lover of brackish water, and may be found in tidal creeks in vast numbers associated with Mummichogs, Silversides and Eels, feeding upon Shrimp and Minnows. Spawning takes place in May and June. According to Pro-



SÉA BASS [*CENTROPRISTES STRIATUS*].

fessor John A. Ryder, the egg of the White Perch is very adhesive, and on this account is troublesome to hatch artificially. In the experiments made by him the eggs were taken upon cotton yarn, which was drawn up through a funnel into which the eggs and milt had been squeezed from the spawning fish. The cord, covered with the adhering eggs, was then wrapped upon a wooden reel and sent under cover of damp cloths to the central station, where they arrived in fine condition, almost every egg being impregnated. This system was devised and carried out under the superintendence of Col. M. McDonald. After reaching the central station the cotton cord with the adhering eggs was cut into lengths of 10 or 12 inches and suspended in the glass hatching jars. The development was soon interfered with by the growth of fungus. When the wooden reel with the adhering eggs was introduced into a wide aquarium fungus also attacked the eggs as before but the results were somewhat more favorable. With the water at 58° to 60° F. the eggs hatched out in 6 days.

The White Perch congregates in large schools and is one of the freest biters among fishes. The shrimp is one of the best baits, though worms, sturgeon eggs, Minnows and strips of cut fish with silvery skin are equally effective. Dr. Abbott has known as many as 20 dozen to be taken with a line in a few hours, and Spangler mentions catches of six or seven hundred in a day by two rods, the fish ranging in weight from $\frac{3}{4}$ to $1\frac{1}{4}$ pounds.

Eugene Smith, on several occasions, found a long, green, brackish-water alga (*Enteromorpha*) in stomachs of White Perch, indicating that they sometimes eat vegetable matter, though perhaps only for the minute organisms found upon it.

In captivity the fish is very susceptible to fungus attacks, but the parasite is readily killed by changing the water supply from salt to fresh, or vice versa.

114. Sea Bass; Black Fish (*Centropristes striatus* Linnæus).

Perca varia MITCHILL, Rept. Fish. N. Y., 11, 1814; Trans. Lit. & Phil. Soc. N. Y., I, 415, pl. 3, fig. 6, 1815, New York.

Centropristes nigricans DEKAY, N. Y. Fauna, Fishes, 24, pl. 2, fig. 6, 1842; BEAN, 19th Rept. Comm. Fish. N. Y., 266, pl. XVII, fig. 21, 1890.

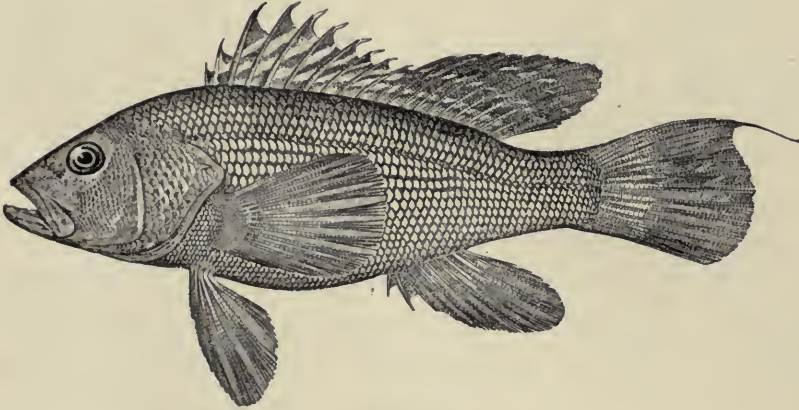
Centropristes striatus JORDAN & EIGENMANN, Bull. U. S. F. C., VIII, 391, pl. 64, 1890; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1199, 1896, pl. CXC, fig. 500, 1900; BEAN, Bull. Am. Mus. Nat. Hist., IX, 366, 1897; H. M. SMITH, Bull. U. S. F. C., 1897, 100, 1898; BEAN, 52d Ann. Rept. N. Y. State Mus., 105, 1900.

Dusky brown or black, adults often bluish, more or less mottled, with traces of pale longitudinal streaks along the rows of scales; young greenish, often with a dark

lateral band, sometimes broken up forming cross-bars; dorsal fin with several series of elongate, whitish spots, forming interrupted lines; other fins dusky, mottled.

The Sea Bass is the *Perca varia* of Mitchill, *Fish. N. Y.* p. 415. Common names given by this author are Sea Basse, Black-Harry, Hanna Hills and Blue fish. Schoepff (1787) gives the New York name as Black fish; DeKay has it as the Black Sea Bass, also Black Bass and Black fish. Dr. Storer records the Massachusetts name of Black Perch. Other common names on the coast are Black Will (Middle States) and Rock Bass (New Bedford).

The Sea Bass is found from Vineyard Sound southward, its southern limit not being accurately determined, but probably not extending below Cape Hatteras. The southern form, which was described by Linnæus from South Carolina, may be distinct from the northern, and if so it should be designated by the Linnæan name *atraria*.



SEA BASS.

The northern form has been found occasionally north of Cape Cod, at Nahant, Salem, and Beverly Bar. Dr. Smith reported it as very common at Woods Hole in 1898, where it arrives in May and departs from the inshore waters about October 1, being most abundant from July to September. It spawns there in June. The young are first seen about August 1. The maximum weight is 6 pounds. In 1900 the Sea Bass was said to be remarkably scarce at Woods Hole. According to the observers of the Fish Commission this fish is decreasing rapidly in numbers. Hand-lining, even on the spawning grounds off Hyannis was remarkably poor and young fish were less numerous than usual. As a rule the first adults appear in their seasonal migration during the first or second week in May, when the water has reached a temperature of 48° to 50° F. However, in spite of the cold of 1900, they appeared at Cuttyhunk and Menemsha Bight on April 28—with one exception the earliest

arrival recorded in 25 years. Formerly the young were abundant everywhere, but at present they are restricted to a few localities—Katama Bay, Quisset Harbor and Wareham River. The first fry were seined July 31 and measured $\frac{3}{4}$ of an inch in length. On October 20, young fish 2 to 3 inches long were very plentiful in Katama Bay.

In 1884 the writer obtained young examples only, and these in moderate numbers, at Fire Island near the end of September. In 1890 a few individuals were observed in a net at Islip. In 1898, adults were taken in abundance off shore at Southampton in August and half-grown specimens were secured from a pound at Islip. Young Sea Bass were rather common at Point of Woods, Great South Bay, Clam Pond Cove, Fire Island Inlet, Oak Island Beach, and Nichols's Point. In the summer of 1901, early July to the middle of October, only a few young individuals were taken, and these were secured in eel pots off Widow's Creek, Great South Bay.

The Sea Bass makes its appearance in Gravesend Bay in May. It is not abundant. The young in October are found in the eel grass, measuring from $1\frac{1}{2}$ to 2 inches in length. The species is well adapted to life in aquarium tanks during all but the coldest months.

The Sea Bass is distinguished for its voracity and its persistent biting. The young are found in the channels of shallow bays and about wharves and landings. Large fish frequent the off-shore banks where the bottom is rocky. A famous locality is Five Fathom Bank, off the coast of New Jersey. In the shallow waters of Great Egg Harbor Bay, hundreds of small-sized Sea Bass may be taken in a day, and it is difficult to find a locality which is free from them. Their food consists of shrimps, crabs, sea worms, squid, small fishes and all other animals of suitable size. The species is sluggish in its habits and resembles the *Tautog* in its tendency to hide in rock crevices. The Sea Bass breeds in the summer months and the young grow rapidly. The eggs have been hatched artificially, and when it becomes desirable the fry can be produced in vast quantities. The eggs are $\frac{1}{26}$ of an inch in diameter and hatch in 5 days in water at the temperature of 59° or 60° F. At Woods Hole, Mass., they are deposited in June.

This is a valuable food fish, reaching a length of 18 inches and the weight of 6 pounds.

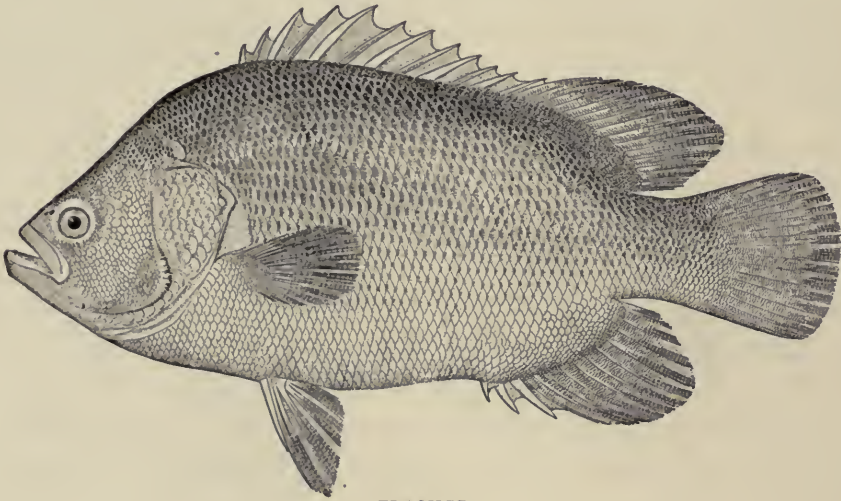
115. Flasher; Triple-tail (*Lobotes surinamensis* Bloch).

Holocentrus surinamensis BLOCH, Ichth., pl. 243, 1790, Surinam.

Bodianus triurus MITCHILL, Trans. Lit. & Phil. Soc., I, 418, pl. III, fig. 10, 1815, Powles Hook, N. J.

Lobotes auctorum GÜNTHER, Cat. Fish. Brit. Mus., I, 338, 1859.

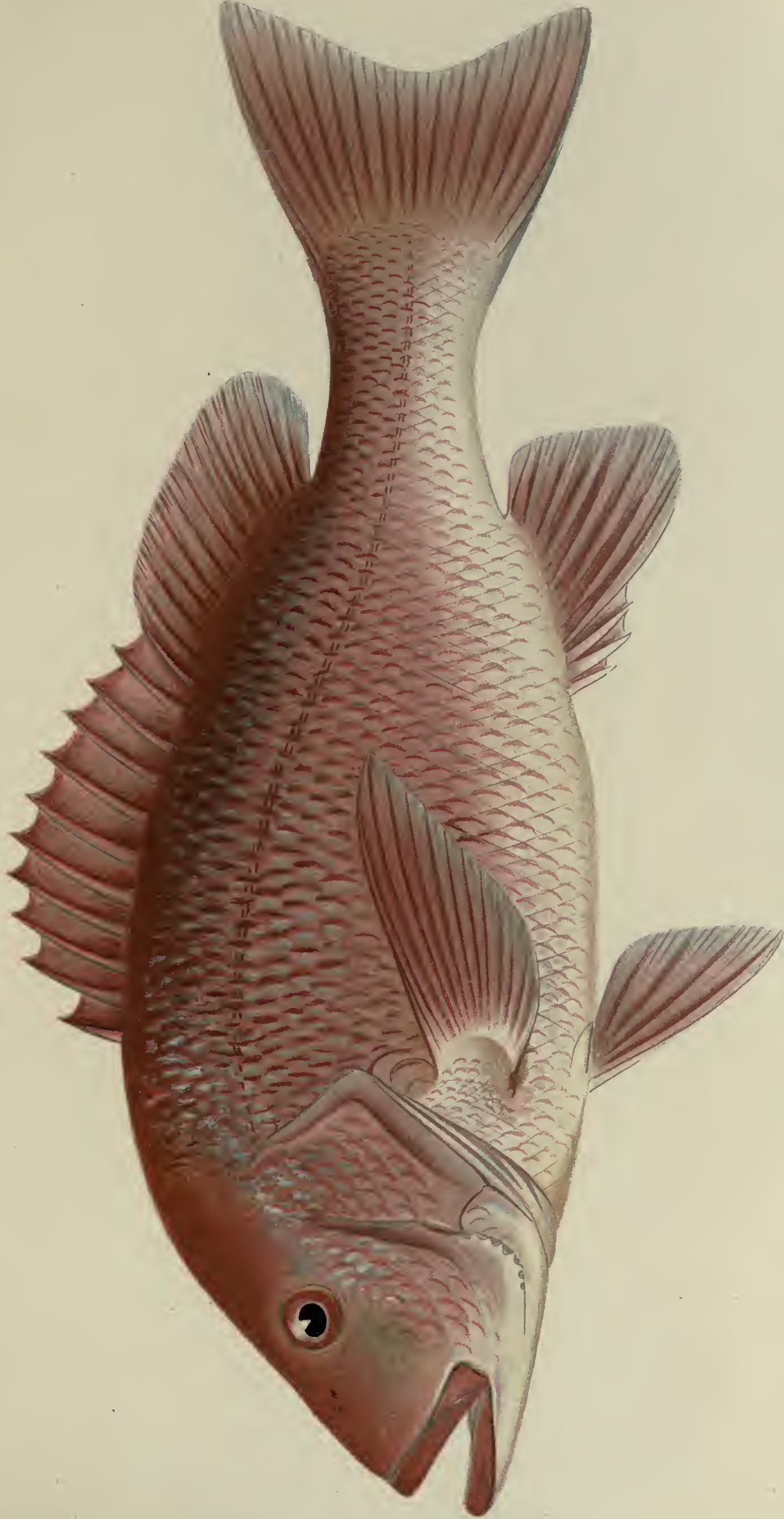
Lobotes surinamensis CUVIER & VALENCIENNES, Hist. Nat. Poiss., V, 319, 1830; DEKAY, N. Y. Fauna, Fishes, 88, pl. 18, fig. 49, 1842, New York; HOLBROOK, Ichth. S. C., ed. 1, 159, pl. 23, fig. 2, 1856; JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 555, 1883; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1235, 1896, pl. CXCIV, fig. 510, 1900; H. M. SMITH, Bull. U. S. F. C. 1897, 100, 1898; SHERWOOD & EDWARDS, Bull. U. S. F. C. 1901, 28, 1901, Narragansett Bay.



FLASHER.

Blackish above, silvery gray on the sides, often blotched and tinged with yellow; fins dusky gray, sometimes mingled with yellow.

The Flasher is a large species, found in all warm seas, ranging on our coast from Cape Cod to Panama; it reaches the length of 3 feet and is used for food. At Woods Hole, according to Dr. Smith, it is very rarely taken. Specimens were secured, however, in August, 1873, December, 1875, September 20, 1886, and in August, 1890. The individual obtained in 1886 was caught in a trap at Menemsha, Martha's Vineyard. The Rhode Island Fish Commission has a specimen weighing 6 pounds and measuring 22 inches, which was taken September 10, 1900, in a trap off Prudence Island, Narragansett Bay. The example described and figured by Mitchill was taken at Powles Hook, N. J. According to Mitchill specimens weighing 4 or 5 pounds were occasionally secured, and the fish was sometimes called Black Grunt. DeKay knew the fish only from the accounts of it given by Mitchill and Holbrook.



RED SNAPPER (*NEOMÆNIS BLACKFORDI*).

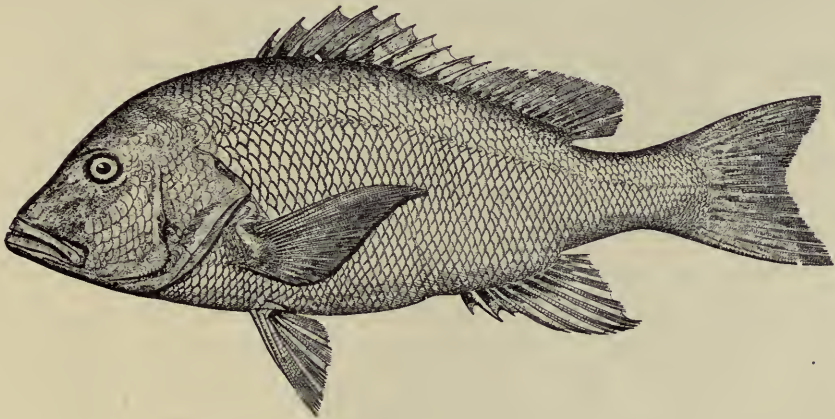
116. Red Snapper (*Neomænis blackfordi* Goode & Bean).

Lutjanus blackfordii GOODE & BEAN, Proc. U. S. Nat. Mus., I, 176, 1878 (full description of adult); II, 137, 138, 1879, characters and measurements of young; GOODE, Game Fishes N. A., 16, 1878, with colored plate.

Lutjanus blackfordi JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 549, 1883; BEAN, 19th Rept. Comm. Fish. N. Y., 263, pl. XVI, fig. 20, 1890.

Neomænis aya JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1264, 1898, pl. CXCVII, fig. 516, 1900 (not *Bodianus aya* BLOCH, Ichth., 227, 1790); H. M. SMITH, Bull. U. S. F. C. 1897, 100, 1898.

Color uniform scarlet. Center of scales lighter, also the belly, which is silvery; inside of axil of pectoral darker maroon.



RED SNAPPER.

On October 26, 1887, Mr. E. G. Blackford, Fish Commissioner of the State of New York, forwarded to the National Museum a young Red Snapper, four and one half inches long, which was caught in Great South Bay, at Bay Shore, Long Island. This is the smallest Red Snapper that we have obtained, and it is the first record of the occurrence of the species so far north. The specimen has been catalogued as 39,213 of the National Museum Fish Register.

As in other young fishes the size of the eye, the length of the head and the colors are different from these characters in the adult.

A description of the colors of the fresh fish follows :

A dark band nearly as wide as the diameter of the eye is placed immediately in front of the spinous dorsal; it fades out about the median line of the body. Three similar bands, and of like size, under the dorsal, separated by narrow interspaces and fading out below. The fourth band contains a blotch as large as the eye, which passes slightly beneath the lateral line. A fifth band is under the last third of the

soft dorsal and continues backward to the caudal, not descending below the lateral line. The second and third bands are traversed vertically by a narrow median stripe of the rosy body color. Membrane of dorsals and caudal with a narrow black edge. Spine and external ray of ventral milk white. Anal rosy, except membrane of first two spines and last three rays, which is milk white.

The Red Snapper has become one of the most famous fishes of our northern markets, and is always attractive on account of its large size, brilliant color, and the excellence of its flesh. We know that the species is to be found on our east coast from Cape Cod to the Carribbean Sea. It is rare, however, north of Cape Hatteras and the principal fisheries are located off the coasts of Georgia and Florida, and in the Gulf of Mexico.

When the Red Snapper was named in honor of Mr. Eugene G. Blackford, in recognition of his invaluable contributions to the science of ichthyology, the describers of the species had carefully considered the question of nomenclature and satisfied themselves that none of the names known to them could with certainty be associated with this fish. Various earlier names have been suggested from time to time by several authors as possibly available for the species. In 1883 Dr. D. S. Jordan considered it to be the *L. campechianus*, described by Poey in 1860. This, however, is a species with much smaller scales if the description be accurate. The type has not been examined by any one in the United States so far as I am informed. A little later Dr. Jordan suggested that the name *Lutjanus vivanus* of Cuv. & Val. should be accepted for the Red Snapper; but my examination of the types of this species in the Museum of Paris showed it to be a small *Lutjanus*, and very distinct in every way from *L. blackfordi*. In recent lists Dr. Jordan has adopted the specific name *aya* of Bloch, published in 1787 in the *Ausländische Fische*. This name was used for a species of *Lutjanus* more than twenty years ago by Dr. Theodore Gill.

I will now state what may be learned from the literature concerning the *aya*. The *Bodianus aya* of Bloch is distinctly based upon the *Acara aya* of Maurice, Prince of Nassau, as set forth in his Mss, tome 2, page 351. The plate published by Bloch is copied from a drawing by Prince Maurice, and his description is drawn from the same source. The fish which formed the subject of the description and illustration by the Prince of Nassau was the *aya* or *garanha* of Brazil, a red species, said to attain to a length of 3 feet. The *aya* is distinctly described as having 9 spines and 18 articulated rays in the dorsal. It is represented as having 40 scales in the lateral line, and the scales are said to be ornamented with silvery, submarginal stripes. Bloch was informed that the fish was known to the French, Germans and

English as the *aya* and to the Brazilians as the *garanha*. Elsewhere in the description the general color is said to be red, the back dark red, and the belly silvery. This is all the information to be derived from Bloch's account of the species, and if the data mentioned are to be relied upon, the fish is certainly not our Red Snapper. We have no other knowledge concerning the *aya* of Brazil. It has not been shown that our species ranges so far south and several red forms resembling *L. blackfordi* are associated with it. Various interpretations of the *aya* have appeared in ichthyological works. Dr. Günther, in his *Catalogue of Fishes in the British Museum*, vol. I, page 198, adopts the name for a small-scaled *Lutjanus*, which has 65 scales in the lateral line and 32 in a transverse series. Of this he has a fine specimen from South America. A very curious translation of the earlier descriptions of the *aya* is to be found in Lacépède's account of the species, which is given below. The diagnostic characters are stated as follows:

Nine spines and 18 articulated rays in the dorsal; 1 spine and 8 divided rays in the anal; the caudal crescent-shaped; each opercle terminating in a long and flat spine; the general color red; the back blood color; the belly silvery.

The author, in another part of his *Natural History of Fishes*, writes:

A figure of the *aya* has been published by Marcgrave, Piso, Willughby, Johnston, Ruysch, the prince of Nassau [Maurice] and Bloch, who has copied the drawing of Prince Maurice. It is found in lakes of Brazil. It frequently reaches a length of 1 meter, and it is so plentiful that large numbers of this species are salted or sun-dried for export. It may be very desirable and, perhaps, sufficiently easy to acclimatize this large and beautiful *bodianus*, the flesh of which is very agreeable to the taste, in the fresh waters of Europe, and particularly in lakes and ponds of France.

117. Pig Fish; Hog Fish (*Orthopristis chrysopterus* Linnæus).

Labrus fulvomaculatus MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 406, 1815, New York.

Haemulon fulvomaculatum DEKAY, N. Y. Fauna, Fishes, 84, pl. 7, fig. 21, 1842, New York.

Orthopristis chrysopterus BEAN, Bull. U. S. F. C., VII, 142, pl. III, fig. 11, 1888; BEAN, Bull. Am. Mus. Nat. Hist., IX, 366, 1897; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1338, 1898, pl. CCX, fig. 541, 1900.

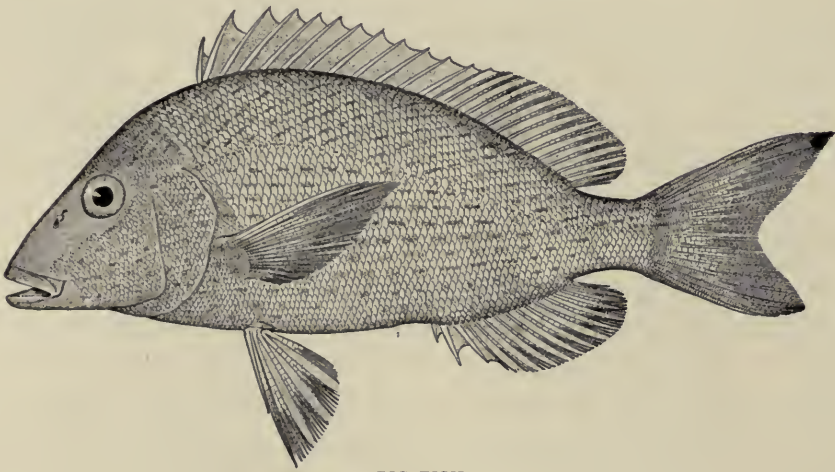
Light brown, silvery below; sides with numerous orange colored and yellow spots; those above the lateral line in oblique series, those below in horizontal; vertical fins with similar spots; head bluish with yellow spots; angle of mouth and gill membranes with orange.

The Pig Fish ranges along the Atlantic coast from New York southward; adult

individuals are rarely seen even as far north as New Jersey, but the young are common.

At Beesley's Point, N. J., August 10, 1887, many young individuals were taken in the seine. D. XII, 16; A. III, 13; scales, 75.

A dark stripe beginning on nape and dividing sends one branch along the back on each side not far from dorsal outline; a dark stripe from eye to root of caudal; cheeks and opercles with several narrow orange stripes; a narrow orange stripe between the two dark body stripes and another below the lower dark stripe; below the second orange stripe are numerous orange spots, not continuous. These specimens are from less than 1 inch to more than 2 inches long.



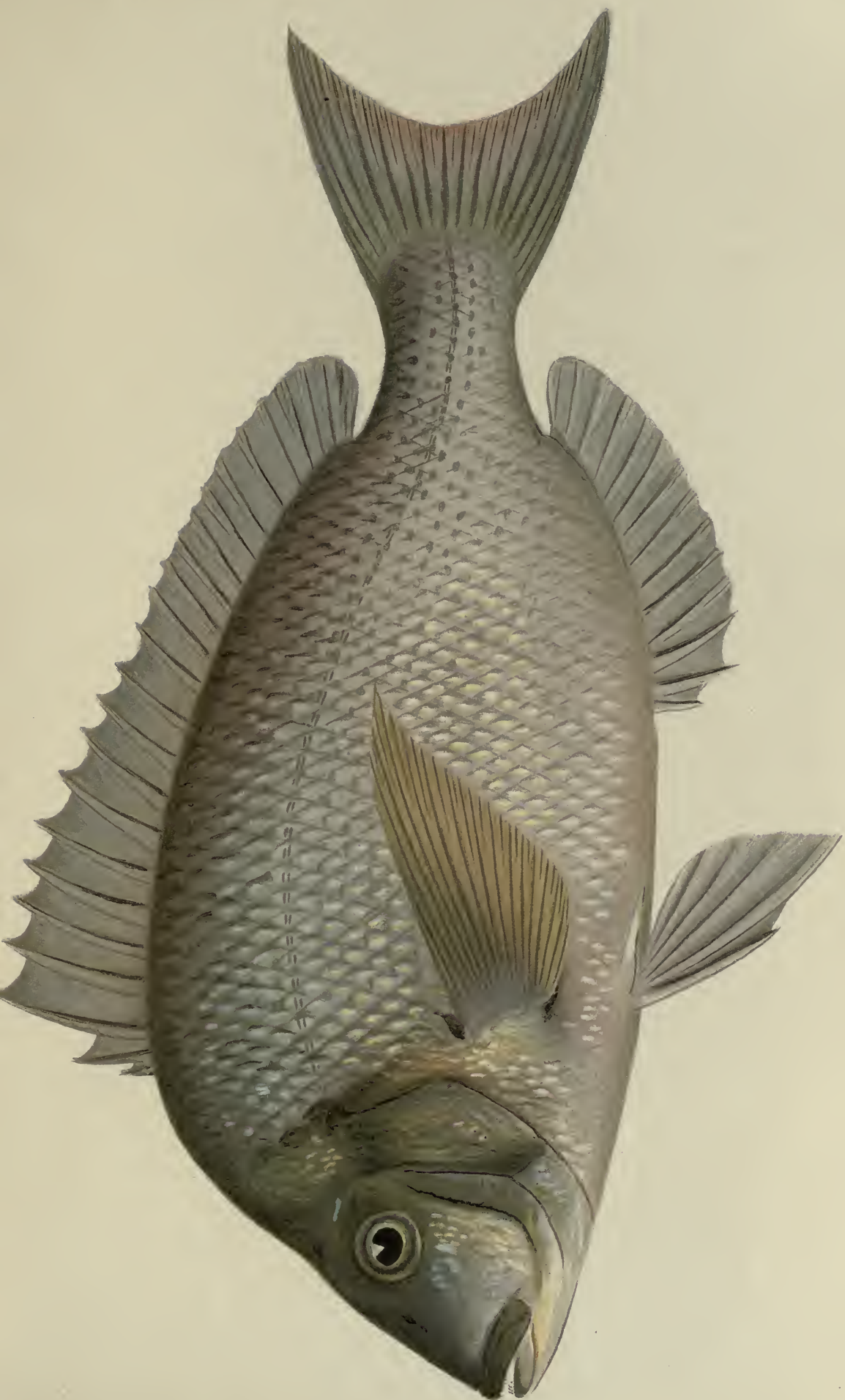
PIG FISH.

Young examples were seined at Somers Point, August 13, and abundantly at Ocean City, August 16. The croaking sound made by these little fishes is quite noticeable.

September 5, Mr. W. S. Keates brought in two examples which had been caught on a hook with clam bait; these are $5\frac{1}{4}$ inches long, and much larger than the average size. Specimens from $4\frac{1}{2}$ to 5 inches long were caught at Beesley's Point August 23; in these there is only a trace of the black lateral stripe along the median line, and the sides have several broad, dark bands.

September 9 an individual $5\frac{1}{3}$ inches long was taken at Beesley's Point. This species is unknown to the fishermen. One angler described its croaking as resembling the quacking of a duck.

Several examples were taken in Gravesend Bay, October 24, 1894. DeKay mentions it as a rare fish, but occasionally appearing, he was informed, in New York Harbor in considerable numbers. He states that it is a very savory food.



SOLID BODY (STENOTOMUS CHRYSOPS)

118. Scup ; Porgy ; Sand Porgee (*Stenotomus chrysops* Linnæus).

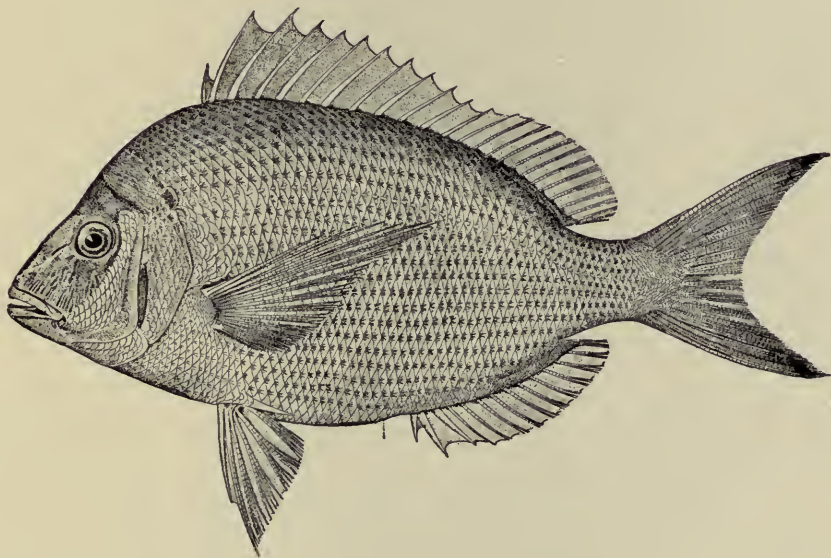
Labrus versicolor MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 404, pl. III, fig. 7, 1815, New York.

Sargus arenosus DEKAY, N. Y. Fauna, Fishes, 91, pl. 22, fig. 67, 1842, Long Island; young.

Pagrus argyrops DEKAY, op. cit. 95, pl. IX, fig. 25, 1842; adult.

Diplodus argyrops JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 557, 1883.

Stenotomus chrysops BEAN, Bull. U. S. F. C., VII, 142, 1888; 19th Rept. Comm. Fish. N. Y., 261, pl. XIV, fig. 18, 1890; JORDAN & FESLER, Rept. U. S. F. C. 1889 to 1891, 507, 1893; BEAN, Bull. Am. Mus. Nat. Hist., IX, 366, 1897; H. M. SMITH, Bull. U. S. F. C. 1897, 100, 1898; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1346, 1898, pl. CCXI, fig. 544, 1900; BEAN, 52d Ann. Rept. N. Y. State Mus., 106, 1900; SHERWOOD & EDWARDS, Bull. U. S. F. C. 1901, 28, 1901.



SCUP.

Color silvery, with bright reflections, dusky above, upper part of head deep brown; dorsal horn color, the last rays with a yellowish tinge; axil of pectoral dusky; young with five or six dusky bars; iris golden, mottled with silvery and brownish. Length, about 1 foot.

The Scup is one of our best known fishes. In many places it is better known under the name Porgee. Mitchill and DeKay described it as the Big Porgee. Another spelling for the same name is Pogy. Scup is an abbreviation of Scuppaug, which in turn is a shorter form for the Narragansett name, Mishcuppauog. The name Fairmaid, which is said to be given to the Scup on the Virginia coast, does not rightfully belong to this species, but rather to the Sailor's Choice (*Lagodon*). The

name Fairmaid is regularly applied to the latter species at Cape Charles, Va., according to B. A. Bean. In Norfolk, Va., Mr. Bean heard the name Maiden for the young of the common Scup.

The Scup seldom migrates north of Cape Cod, although it has been taken occasionally off Cape Ann. Attempts to introduce it into Massachusetts Bay have been unsuccessful.

The Scup comes into our northern waters in great schools, the large spawning fish coming first, making their appearance in New York waters in May. The species feeds upon small crustaceans, mollusks and annelids, and is one of the readiest biters along the coast. The fishery fluctuates greatly; in certain years the fish is comparatively scarce, and in others it is extremely abundant. It is caught in pounds and traps, and remains in Great South Bay until cold weather sets in. It has been taken on Cape Cod as late as December 10. Sometimes a sudden cold spell kills the fish in large numbers.

In 1890 we found only a few specimens at Fire Island and at East Island, late in September, and on October 1 a few examples were taken in a trap at Islip. In 1898 adults were taken in moderate numbers off Southampton August 3. Half-grown specimens were obtained at Islip August 18. A single young individual was seined at Nichols's Point September 1, and a moderate number of young, about 2 inches long, were secured at the east side of Fire Island Inlet September 16. In 1901 small Scup, about 6 inches long, were obtained in a gill net August 13, and in Watt's Pound, July 31, in Clam Pond Cove.

The Scup arrives in Gravesend Bay in May, and is taken as late as November. In captivity it lives until December, and in properly heated water it can be kept indefinitely. It is thrifty, and is seldom in bad condition.

At Woods Hole, Mass., according to Dr. Smith, the fish appears about May 1 and leaves about October 15 or 20, being most abundant in June and July. Spawning occurs during first part of June, and young $\frac{1}{2}$ inch to $\frac{3}{4}$ inch long are observed by the middle of July. The eggs are $\frac{1}{26}$ inch in diameter and hatch in 4 days at a mean temperature of 62° F. In 1900 the Scup arrived off Newport April 21, at Cutty Hunk April 26, and at Woods Hole May 1. Hundreds of young are killed there annually by a sudden fall of temperature. The growth of the young is recorded by Sherwood & Edwards as follows: July 3, length $\frac{1}{2}$ to $1\frac{1}{2}$ inches; August 2, $1\frac{1}{2}$ to 2 inches; September 6, 2 to 3 inches; September 29, 3 to 4 inches; November 1, 4 inches. The largest individuals observed weighed 3 pounds.

The young are devoured in large numbers by Cod, Weakfish, Bluefish and other predaceous species.

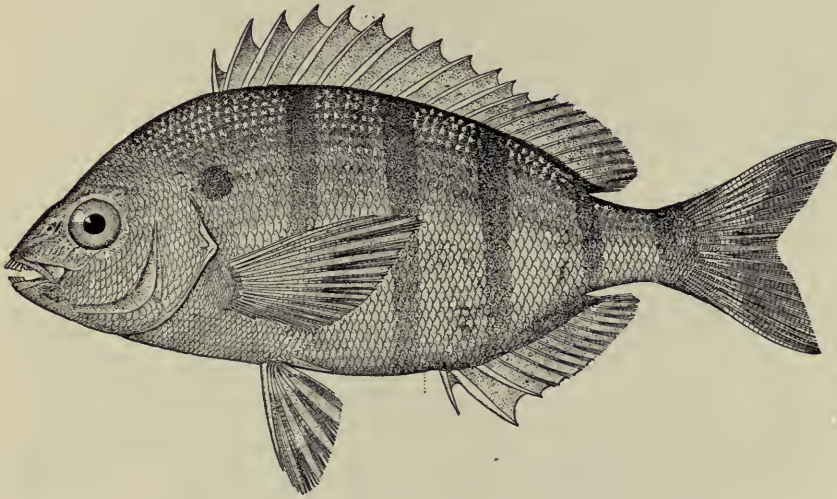
119. Sailor's Choice (*Lagodon rhomboides* Linnæus).

Sargus rhomboides DEKAY, N. Y. Fauna, Fishes, 93, pl. 71, fig. 228, 1842, copied from CUVIER & VALENCIENNES.

Lagodon rhomboides HOLBROOK, Ichth. S. C., ed. 1, 56, pl. 8, fig. 1, 1856; ed. 2, 59, 1860; BEAN, 19th Rept. Comm. Fish. N. Y., 263, 1890; Bull. Am. Mus. Nat. Hist., IX, 366, 1897; H. M. SMITH, Bull. U. S. F. C. 1897, 101, 1898; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1358, 1898, pl. CCXV, fig. 552, 1900.

The Sailor's Choice feeds upon small invertebrates and Minnows. It is caught with the hook and in cast nets and seines.

Brownish, white below; sides of head and body with horizontal stripes of light



SAILOR'S CHOICE.

blue and golden; six or seven very faint darker vertical bands, disappearing with age; vertical fins yellowish, with bluish stripes; a dark axillary spot.

This is called the Salt Water Bream by Schœpff and the Rhomboidal Porgee by DeKay. In Chesapeake Bay it is the Fairmaid. It is also called Pin fish, Squirrel fish, Porgee, Yellow Tail and Shiner. In Great South Bay the name of the fish was unknown to the fishermen, and this is true in Great Egg Harbor Bay, where the young are not uncommon in summer.

In Gravesend Bay it is not a common fish, but is found occasionally in summer.

A single individual was obtained at Fire Island October 1. The Sailor's Choice occurs as far north as Cape Cod, but it is not present in sufficient numbers to be considered among the important food fishes; south of Cape Hatteras, where it is

abundant, it is valuable for food, and in many places is considered superior to Sheepshead; this is especially so in the St. John's River.

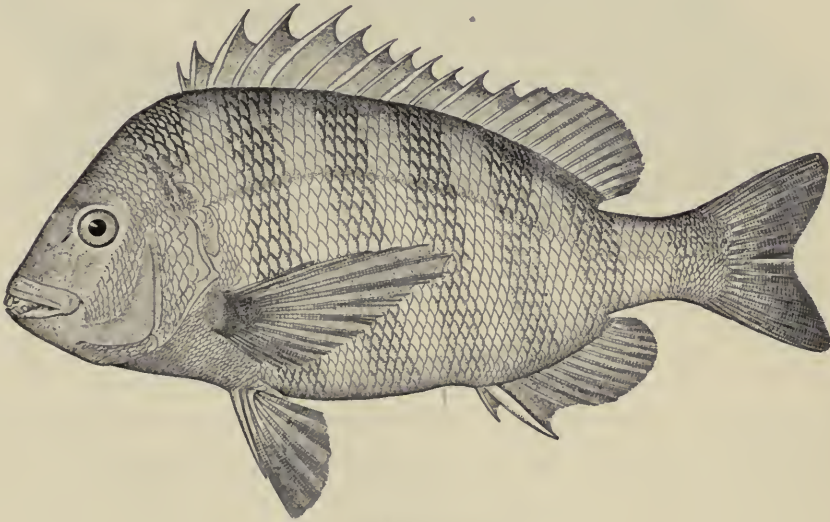
The eggs are described as pale blue in color and as large as mustard seed. Spawning takes place in the Gulf of Mexico in winter or spring. The colors of the fish are very beautiful, the sides being ornamented with golden stripes on a pearly white ground and having numerous dark vertical bands.

120. Sheepshead (*Archosargus probatocephalus* Walbaum).

Sparus ovis MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 392, pl. 2, fig. 5, 1815, New York.

Sargus ovis DEKAY, N. Y. Fauna, Fishes, 89, pl. 8, fig. 23, 1842.

Archosargus probatocephalus BEAN, Bull. U. S. F. C., VII, 142, pl. III, fig. 10, 1888, Somers Point, N. J., young; 19th Rept. Comm. Fish. N. Y., 262, pl. XV, fig. 19, 1890; Bull. Am. Mus. Nat. Hist., IX, 366, 1897; H. M. SMITH, Bull. U. S. F. C. 1897, 101, 1898; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1361, 1898, pl. CCXVI, fig. 554, 1900.



SHEEPSHEAD.

Grayish, with about eight vertical black bands, which are about as broad as the interspaces; dorsal dusky; ventral and anal black; base of pectoral dusky; the dark bands are most distinct in the young.

The Sheepshead ranges along the coast from Cape Cod to Texas; it is very rare as far north as Woods Hole, Mass., but in southern waters it is still abundant. The species reaches a length of 30 inches and the weight of 20 pounds; it is one of the most valuable of our food fishes and is highly prized for its game qualities.

In August, 1887, the Sheepshead was known to have bred in Great Egg Harbor Bay, N. J., where about 20 young individuals, measuring from 1 inch to $1\frac{1}{4}$ inches, were seined between August 10 and September 9. Adults at that time were present in the bay, but they were scarce. The bottom was covered with algæ and convenient hiding places were found under the sod banks.

The fish is very unusual in Gravesend Bay, Long Island. A large individual, weighing 13 pounds, was caught September 16, 1897, at Coney Island. That example proved hardy in captivity, and the Sheepshead generally can be easily kept if the water temperature be properly maintained.

The Sheepshead was at one time common in Great South Bay. For this statement we have the authority of Mr. Erastus Gordon, of Patchogue, and the following account from Dr. Mitchill's *Fishes of New York* will substantiate the fact: "The Sheepshead swims in shoals and is sometimes surrounded in great numbers by the seine. Several hundreds have often been taken at a single haul with the long sweeping nets in use at Raynortown, Babylon and Fire Island. They even tell of a thousand brought to land at a draught. . . . This fish is sometimes speared by torchlight in the wide and shallow bays of Queens County and Suffolk. His term of continuance is only during the warmest season; that is, from the beginning of June to the middle of September. . . . I have, however, known him to stay later; for one of the most numerous collections of Sheepshead I ever saw in the New York market was on October 4, 1814; I have seen them as late as the 17th."

Scott, in 1875, referred to Fire Island as a good locality for Sheepshead fishing, and also mentions superior feeding places in the South Bay and about the wreck of the *Black Warrior*, near the Narrows.

We did not obtain the Sheepshead in Great South Bay, and believe it occurs there very rarely at the present time, although fishermen still seek them in a few localities, and, I am informed, occasionally catch one. Dr. Smith says not one has been seen or heard of in Vineyard Sound or Buzzards Bay since 1894; but formerly it was quite common and was often caught while line fishing for Tautog and Scup.

121. Weak Fish ; Squeteague (*Cynoscion regalis* Bloch & Schneider.)

Roccus comes MITCHILL, Rept. Fish. N. Y., 26, 1814, New York.

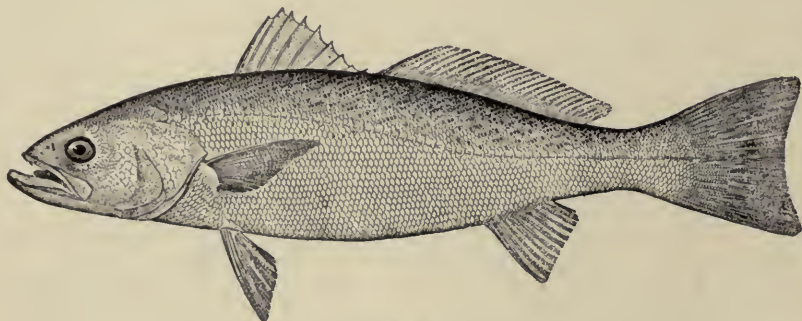
Labrus squeteague MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 396, pl. 2, fig. 6, 1815, New York.

Otolithus regalis DEKAY, N. Y. Fauna, Fishes, 71, pl. 8, fig. 24, 1842.

Cynoscion regale BEAN, Bull. U. S. F. C., VII, 140, pl. II, fig. 6, 1888; 19th Rept. Comm. Fish. N. Y., 257, pl. XIII, fig. 15, 1890.

Cynoscion regalis BEAN, Bull. Am. Mus. Nat. Hist., IX, 367, 1897; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1407, 1898, pl. CCXX, fig. 562, 1900; H. M. SMITH, Bull. U. S. F. C. 1897, 101, 1898; BEAN, 52d Ann. Rept. N. Y. State Mus., 106, 1900; SHERWOOD & EDWARDS, Bull. U. S. F. C. 1901, 29, 1901.

Silvery, darker above and marked with many small, irregular dark blotches, some of which form undulating lines running downward and forward; back and head with



WEAK FISH.

bright reflections; dorsal and caudal fins dusky; ventrals, anal, and lower edge of caudal yellowish, sometimes speckled. The young show traces of a few dusky bands on the sides, one under the spinous dorsal being most plainly marked, and extending to below the median line.

The Weak fish, so called in Dr. Mitchill's *Fishes of New York*, appears also in his report as the Squeteague and Checouts, the former being a Narragansett Indian name and the latter derived from the Mohegans. The Narragansett name is sometimes spelled Scuteeg. Chickwick is the Connecticut name for the species; on Cape Cod, because of the sound produced by the fish, it is called the Drummer; large Weak fish in Buzzards Bay are termed Yellow fins. In Great Egg Harbor Bay the name Blue fish is applied to it, notwithstanding the presence of the real Blue fish (*Pomatomus*). On our southern coast we hear the name Trout, with its variations, Grey Trout, Sea Trout, Shad Trout, Sun Trout and Salt-water Trout. The latter name is used to distinguish it from the Fresh-water Trout of the Southern States,

which is the Black Bass. Dr. Mitchill thus accounts for the name Weak fish: "He is called Weak fish, as some say, because he does not pull very hard after he is hooked; or, as others allege, because laboring men who are fed upon him are weak by reason of the deficient nourishment in that kind of food." DeKay explains the name from the feeble resistance the fish makes on the hook and the facility with which it breaks away from it by reason of its delicate structure. At the time of DeKay's writing in 1842, and for some years previously, the Weak fish were present on our coast in diminished numbers. The Blue fish were then present in abundance and the disappearance of the Weak fish was supposed to be connected with the reappearance of the Blue fish. A similar observation was made by Dr. Storer on the Massachusetts coast. Again, at Woods Hole, Mass., in 1900, the Weak fish were remarkably abundant, the traps at Menemsha having taken 10,000 in a single day; the Blue fish, on the other hand, were unusually scarce during the entire season, not over 50 having been recorded from the adjacent bay and sound.

The Weak fish ranges from the Bay of Fundy to the east coast of Florida. It fluctuates in abundance from year to year. The late Capt. N. E. Atwood is authority for the statement that in 1845 the weekly supply in the New York markets was not above 1,000 pounds.

The earliest arrival in New York in 1889 was on May 12, at Great Hills, Gifford, Staten Island. During the latter part of August, 1889, the west channel of Great South Bay furnished great numbers of Weak fish. The young were found in Blue Point Cove late in September; also some half-grown individuals. The fish are in their finest condition during the fall migration in September and October.

In 1901 young Weak fish were seldom taken in Great South Bay, and only two localities — Duncan's Creek and Smith's Point — furnished them in very small numbers. Adult fish, however, were remarkably abundant, and were caught in many parts of the bay.

The species feeds in the channels upon Shrimp, Crabs and small fish. In Great South Bay we found them eating large quantities of Anchovies, and the same observation was made in one of the inlets of Great Egg Harbor Bay, N. J. The fish enters the mouths of rivers and migrates freely with the tide.

The species swims in large schools near the surface and is very voracious, destroying the young even of its own kind. A specimen of about 4 pounds, taken at Islip, October 1, 1890, had in its stomach a Weak fish weighing about 6 ounces. Fish of 4 pounds and a little larger were moderately abundant at this date.

Weak fish spawn in New York waters in May, and at Cape Cod about the first of June. The egg is $\frac{1}{28}$ inch in diameter and hatches in two days at an average tem-

perature of 60° F. It is buoyant, and, under natural conditions, is subject to the influence of wind and current. The spawning season is evidently prolonged in some localities; in Great Egg Harbor Bay, for example, young Weak fish only 1 1/8 inches long were taken in August, that is, several months after spawning begun. The most favorable tide for catching this species is generally considered the latter half of the flood and first half of the ebb. At night the Weak fish runs up the creeks to feed in the salt meadows, and will take the hook freely.

Some of the best baits for the Weak fish are the common Shrimp, Soft or Shedder Crabs, pieces of Clam and common Mussel, the white skin of the throat of Weak fish, and sometimes the eye of this species; other good baits are Silversides and Anchovies. In Great South Bay the fish are taken extensively in pound nets and in gill nets. The gill nets are set in the shape of a horseshoe, and the attending sloop sails back and forth across the open end of the horseshoe, one of the crew meanwhile beating the deck with his heels to frighten the fish into the nets. This method, called drumming, is in great disfavor among those who follow other modes of fishing.

The Weak fish endures captivity very well and can be kept during winter in water of the proper temperature. The species is said to reach the weight of 30 pounds.

122. Spotted Weak Fish; Sea Trout (*Cynoscion nebulosus* Cuv. & Val.).

Labrus squeteague var. *maculatus* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 396, 1815 New York; not *Labrus maculatus* BLOCH.

Otolithus carolinensis DE KAY, N. Y. Fauna, Fishes, 72, 1842, extra limit; HOLBROOK, Ichth. S. C., ed. 1, 133, pl. 19, fig. 2, 1856.

Cynoscion nebulosus JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1409, 1898, pl. CCXXI, fig. 563, 1900.

Body silvery with bright reflections; numerous black spots on back, beginning under the spinous dorsal; soft dorsal and caudal similarly spotted, the largest spots smaller than pupil; anal fin dusky.

The Spotted Weak fish is a better food fish than the common northern species; it ranges from New York to Texas, but is rare north of Virginia.

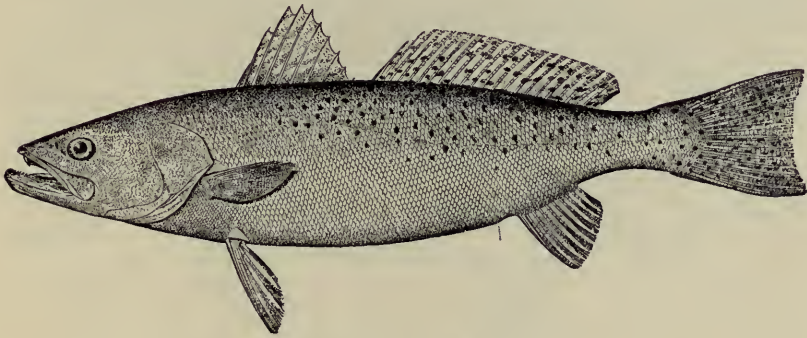
123. **Yellow Tail ; Silver Perch** (*Bairdiella chrysura* Lacépède).

Bodianus argyroleucus MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 417, pl. 6, fig. 9, 1815, New York.

Corvina argyroleucas DEKAY, N. Y. Fauna, Fishes, 74, pl. 18, fig. 51, 1842, New York.

Homoprion xanthurus HOLBROOK, Ichth. S. C., ed. 1, 170, pl. 24, 1856 (not *Leiostomus xanthurus* LACÉPÈDE).

Bairdiella chrysura GOODE, Fish. & Fish. Ind. U. S., I, 375, pl. 126, 1884; BEAN, Bull. U. S. F. C., VII, 141, pl. I, fig. 9, 1888; 19th Rept. Comm. Fish. N. Y., 259, 1890; Bull. Am. Mus. Nat. Hist., IX, 367, 1897; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1433, 1888, pl. CCXXII, fig. 566, 1900; BEAN, 52d Ann. Rept. N. Y. State Mus., 106, 1900.



SPOTTED WEAK FISH.

Greenish above, silvery below, each scale with series of dark punctulations through the center, usually very conspicuous, sometimes obscure, these forming narrow somewhat irregular streaks along the sides; fins plain, the caudal yellowish.

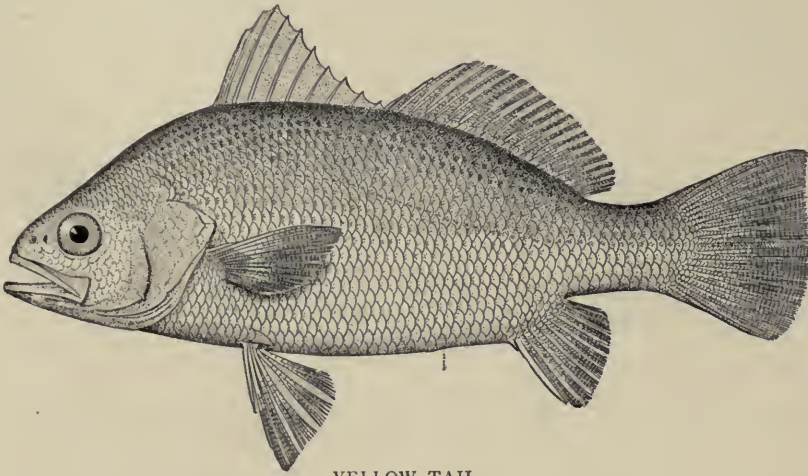
Dr. Mitchill describes this fish as the Silver Perch, and DeKay explains the origin of this name from the resemblance which the Yellow Tail bears in its appearance and habits to the common White Perch. At Pensacola, Fla., the name *Mademoiselle* is applied to the species. In Great South Bay we heard the name *Lafayette* given it, but this belongs more properly to the Spot, *Leiostomus xanthurus*.

The Yellow Tail occurs on our coast from Cape Cod to Florida. It was a common fish in Great South Bay in September, 1890, and during the early part of October, occurring at Blue Point Cove, at the Blue Point Life Saving Station, Great River Beach and Fire Island. It is frequently taken in the pounds. In 1898 the young were found in abundance at Nichols's Point, Great South Bay, September 1. In 1901 the species was not observed at all during a season extending from the middle of July to the middle of October.

The breeding season must continue into early summer, as many young fish from

1 inch to 2½ inches long were obtained in Great Egg Harbor Bay, N. J., early in August.

The young of the Silver Perch are found every summer in Gravesend Bay, and adults are to be seen occasionally. On September 8, 1896, Mr. DeNyse took an example 1¼ inches long with a shrimp net, in eel grass back of the flats at extreme low tide. Pools containing 2 feet of water are common here, and many species of fish become imprisoned in them. In August Mr. W. I. DeNyse has captured a half dozen adult *Hippocampus* in such localities. On October 5, 1896, and again in the fall of 1897, the Silver Perch was obtained in the bay.



YELLOW TAIL.

The species seldom exceeds 10 inches in length, but is regarded as an excellent pan fish, and is secured in enormous numbers.

124. Red Drum ; Channel Bass (*Sciænops ocellatus* Linnæus).

Sciæna imberbis MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 411, 1815, New York.

Corvina ocellata DEKAY, N. Y. Fauna, Fishes, 75, pl. 21, fig. 61, 1842, New York ; HOLBROOK, Ichth. S. C., ed. 1, 149, pl. 21, fig. 2, 1856.

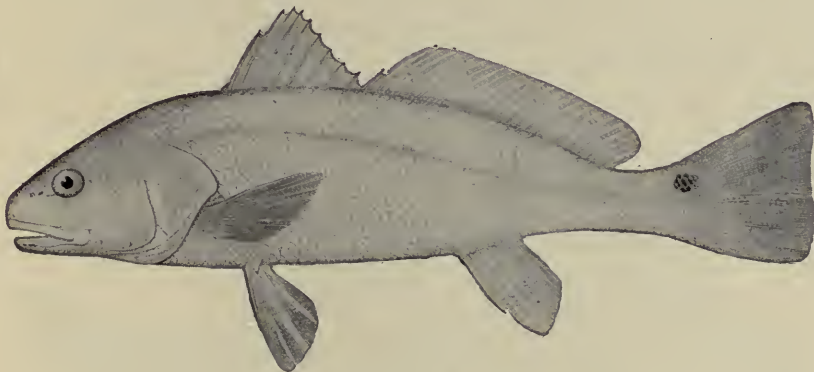
Sciænops ocellatus BEAN, Bull. Am. Mus. Nat. Hist., IX, 367, 1897, New Jersey ; H. M. SMITH, Bull. U. S. F. C. 1897, 101. 1898 ; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1453, 1898, pl. CCXXXII, fig. 567, 1900.

The Red Drum is one of the largest of the food fishes of the southern waters, reaching the length of 5 feet and the weight of 75 pounds. It inhabits the Atlantic coast from New York to Texas, and has once been taken near Cape Cod.

A Red Drum, or Spotted Bass, weighing 14 pounds, was obtained by Mr. E. G. Blackford from New Jersey, and was purchased alive for the New York Aquarium.

When last observed by me (December 11, 1897) it was in the central pool, and apparently, in perfect health. It swam sometimes immediately under the Sand Shark. Its food consists of large pieces of Herring, which it takes readily.

The only specimen known to have been taken at Cape Cod was caught in a trap in Buzzards Bay at the breakwater in 1894. The example is 34 inches long and weighs about 14 pounds. On account of the ocellated markings at the base of the caudal fin it has sometimes been called the Branded Drum.



RED DRUM.

125. Spot; Lafayette (*Leiostomus xanthurus* Lacépède).

Leiostomus xanthurus DEKAY, N. Y. Fauna, Fishes, 70, 1842, extra limital.

Leiostomus xanthurus JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 574, 1883.

Leiostomus xanthurus BEAN, 19th Rept. Comm. Fish. N. Y., 260, 1890; Bull. Am. Mus. Nat. Hist., IX, 367, 1897.

Leiostomus xanthurus EUGENE SMITH, Proc. Linn. Soc. N. Y., 1897, 39, 1898.

Leiostomus xanthurus MEARNS, Bull. Am. Mus. Nat. Hist., X, 321, 1898.

Mugil obliquus MITCHILL, Rept. Fish. N. Y., 16, 1814, New York.

Leiostomus obliquus DEKAY, N. Y. Fauna, Fishes, 69, pl. 60, fig. 195, 1842.

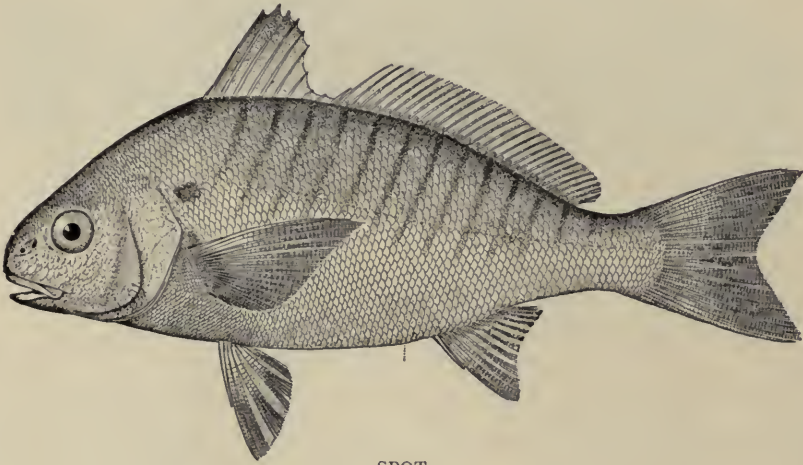
Color bluish above, silvery below; about 13 to 15 narrow dark lines extending from the dorsal fins downward and forward to below the lateral line; a roundish black humeral spot about two-thirds as long as the eye; fins plain olivaceous.

This little fish was formerly known on the New York coast as Lafayette. Mitchill calls it the Little Porgee. According to DeKay its appearance on the New York coast in the summer of 1824 happened to coincide with the arrival of General Lafayette, and his name was bestowed upon the species. The name Spot is derived from the presence of a dark blotch about as big as the eye near the root of the pectoral fin. Other names for the species are Goody, Oldwife, Roach and Chub.

The Spot is found from Cape Cod to Florida and is sometimes abundant as far north as New York. In Great South Bay several specimens were taken early in October in Great River. A single example was seen among some fishes taken in a pound net at Islip, October 1, 1890. In 1898 the species was not obtained by the writer, and in 1901 only a few specimens, mostly adults, were secured at Quantic Bay, Duncan's Creek and Widow's Creek.

Rather common in Gravesend Bay from July to as late as December, and is well adapted to captive life. It is mostly abundant usually in September.

Dr. Mearns states that the fish, locally known as the Sand Porgee, is of frequent occurrence in summer in the Hudson River and its estuaries. H. M. Smith records



SPOT.

it as common in the fall in the vicinity of Wood's Hole, Mass., leaving in October or November, when the water temperature reaches 45° F. All the specimens observed there were about 6 inches long.

It is a small fish, seldom exceeding 10 inches in length, but is one of the favorites among the pan fishes. The Spot feeds upon the bottom on small invertebrates, and can be taken readily with hook and line. In Great South Bay it is caught in seines and pound nets. It ascends creeks into brackish water and is a common associate of the White Perch. In Great Egg Harbor Bay it is extremely common in summer and is sometimes known as Porgee.

126. Croaker (*Micropogon undulatus* Linnæus).

Bodianus costatus MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 417, 1815, New York.

Micropogon costatus DEKAY, N. Y. Fauna, Fishes, 83, pl. 72, fig. 230, 1842.

Micropogon undulatus DEKAY, N. Y. Fauna, Fishes, 84, 1842, extra-limital.

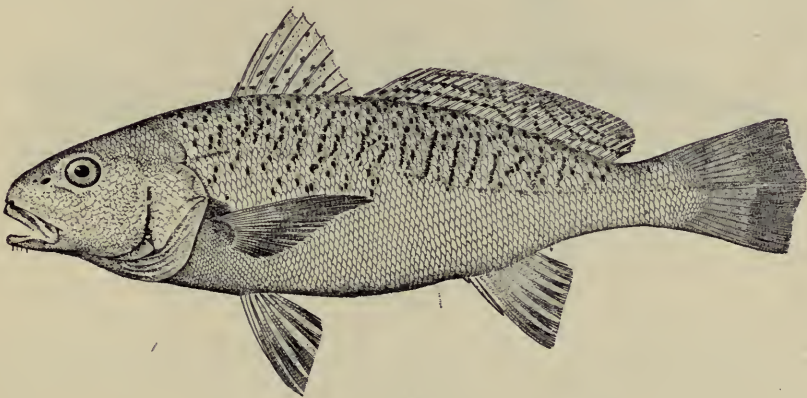
Micropogon undulatus JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 575, 1883.

Micropogon undulatus BEAN, Bull. Am. Mus. Nat. Hist., IX, 368, 1897.

Micropogon undulatus JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1461, 1898, pl. CCXXIV, fig. 570, 1900.

Color grayish silvery, with bright reflections; sides and back with narrow, irregular, undulating lines of dots; dorsal fins with three lines of dots along base.

The Croaker inhabits the east coast of the United States, ranging from Cape Cod to Texas; it is not very common north of the Chesapeake. It grows to the



CROAKER.

length of 15 inches and is an important food fish. The fish was described by Mitchill but was unknown to DeKay from personal observation. Although known in Gravesend Bay, the species is a very uncommon one there. Mr. W. I. DeNyse informs me that several individuals were taken there in September, 1902. The only specimen recorded at Woods Hole, Mass., is 15 inches long; it was taken in a trap at the breakwater in Buzzards Bay on September 9, 1893.

127. King Fish ; Whiting ; Sea Mink (*Menticirrhus saxatilis* Bloch & Schneider).

Sciena nebulosa MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 408, pl. 3, fig. 5, 1815.

Umbrina alburnus DEKAY, N. Y. Fauna, Fishes, 78, pl. 7, fig. 20, 1842.

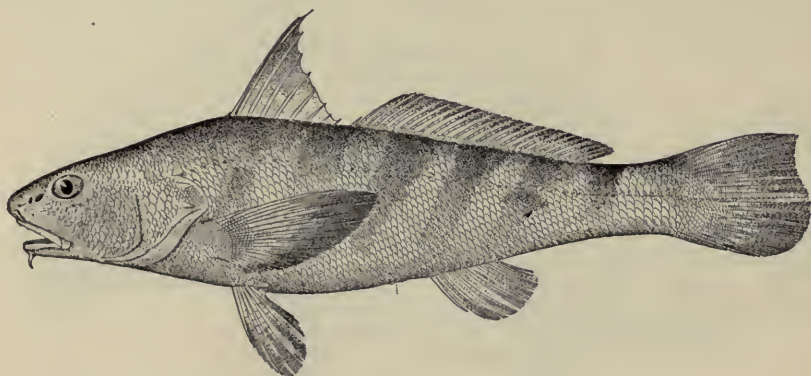
Menticirrhus nebulosus JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 577, 1883.

Menticirrhus saxatilis BEAN, 19th Rept. Comm. Fish. N. Y., 259, pl. XII, fig. 16, 1890.

Menticirrhus saxatilis JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., I, 1475, 1898.

Menticirrhus saxatilis BEAN, 52d Ann. Rept. N. Y. State Mus., 106, 1900.

Color dusky gray above, sometimes blackish, the back and sides with distinct dark oblique cross-bands running downward and forward, the anterior one at the nape extending downward, meeting the second and thus forming a v-shaped blotch on each side ; a dark lateral streak bounding the pale color of the belly, most dis-



KING FISH.

tinct posteriorly, and extending on lower lobe of caudal ; inside of gill cavity scarcely dusky ; pectorals dark.

The King fish, according to DeKay, was so named by the early English colonists because of its excellent flavor. The name Hake is given to it in New Jersey and Delaware ; in the Chesapeake it is sometimes called Black Mullet ; in North Carolina, the Sea Mink ; in the South it is the Whiting or Bermuda Whiting ; on the Connecticut coast it is known as the Tomcod.

The King fish occurs northward to Cape Ann and south to the Gulf of Mexico. Large individuals are not common as far north as Cape Cod, but the young may be seen in moderate numbers in the summer months. They occur in abundance throughout Great South Bay, and near the inlet their number is increased. We have collected them at the mouth of Swan Creek, in Blue Point Cove, at the Blue Point Life Saving Station, Oak Island and Fire Island. An individual was obtained October 7th in the bay, and others were found during September. Adult King fish

used to be common in Great South Bay, but in 1884 they were rare, according to Mr. Erastus Gordon, of Patchogue. In 1898 only one adult was taken by the writer, and that was found in Clam Pond Cove, August 26. Young were seined at Fire Island Inlet, Nichols's Point, Howell's Point, Blue Point Cove, and in Peconic Bay. In 1901 large King fish were not uncommon in Great South Bay, but the young were unusually rare, only two specimens, measuring from $3\frac{3}{4}$ to 4 inches, having been obtained; these were seined at Duncan's Creek September 14.

The King fish was formerly abundant in Gravesend Bay, but it seldom occurs there now.

The species evidently breeds at Woods Hole, Mass. Dr. Smith says that adults full of spawn are common there in June, and uncommon after July 15. The young, about an inch long, appear in the middle of July, and the young are numerous on sandy beaches during the summer and until early October, when they leave, having attained a length of 4 or 5 inches. Some of the young are almost entirely black, while others of the same size, taken at the same time, show the color markings of the adults. The maximum weight there is about 2 pounds.

The species is a favorite in New York waters and well merits its reputation as a choice food fish. It takes the baited hook very readily. Hard clam, cut small, shedder crab, black mussels and various kinds of fish are good baits. It goes in schools and associates with the Weak fish.

128. Drum (*Pogonias cromis* Linnæus).

Pogonias fasciatus DEKAY, N. Y. Fauna, Fishes, 81, pl. 14, fig. 40, 1842.

Mugil grunniens MITCHILL, Rept. Fish. N. Y., 16, 1814, New York.

Mugil gigas MITCHILL, Rept. Fish. N. Y., 16, 1814, New York.

Labrus grunniens MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 105, 1815.

Sciena fusca MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 409, 1815, New York.

Pogonias chromis DEKAY, N. Y. Fauna, Fishes, 80, 1842.

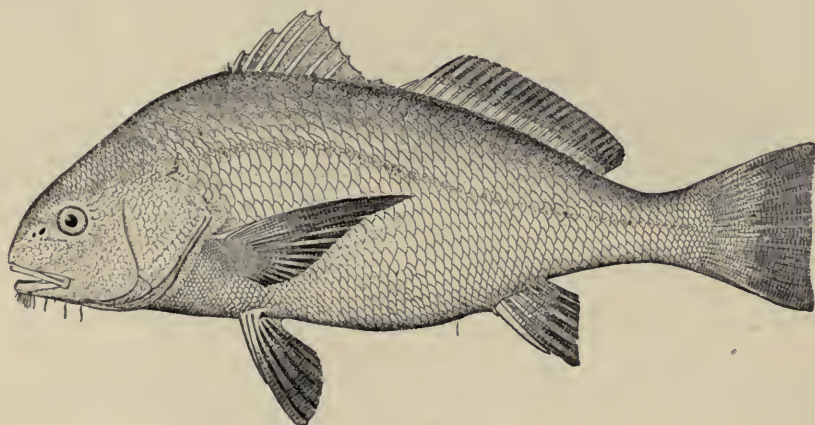
Pogonias chromis JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 568, 1883.

Pogonias chromis BEAN, 19th Rept. Comm. Fish. N. Y., 261, pl. XIII, fig. 17, 1890.

Color grayish silvery, with five dark broad bars, three of which extend upon the dorsal fins, these bars disappearing with age; usually no oblique dark streaks along rows of scales above; fins dusky.

Dr. Mitchill describes the Drum under the names Black Drum and Red Drum. The Black Drum which he described weighed 34 pounds. He had a specimen of 80 pounds, and states that he was credibly informed of one that weighed 101 pounds. The species, according to Dr. Mitchill was taken abundantly during the summer

with line and net. The name Drum, he says, is derived from the drumming noise made by the fish immediately after being taken out of water. "He swims in numerous shoals in the shallow bays on the south side of Long Island, where fishermen during the warm season can find them almost like a flock of sheep; is a dull sort of fish." The Red Drum he considered merely a variety of the Black Drum. Dr. DeKay says of the species, which he calls the Big Drum: "They are gregarious, and frequently taken in great numbers by the seine during the summer along the bays and inlets of Long Island." DeKay adopted a different specific name for the young of this species, and called it the Banded Drum. Other names for this stage given by DeKay are: Grunter, Grunts, Young Drum and Young Sheephead. He saw the young in September, and states that it is found in New York waters also in October and November. The adults, according to DeKay, are a coarse food, but the young are considered a great delicacy.



DRUM.

The Drum is occasionally taken on our coasts as far north as Cape Cod; southward it extends to the Gulf of Mexico.

The Drum is an occasional summer visitor in Gravesend Bay. In the fall of 1896 14 young individuals, 8 inches long, were brought from there alive to the aquarium, and lived until February 10, 1897, when the low temperature of the water (38°) killed them. In the fall of 1897 none were seen in the bay.

In the vicinity of Woods Hole, Mass., the Drum is very rare. Dr. Smith records the first one as having been taken May 7, 1874, and it has been observed only three or four times since. The recent specimens have been caught in traps at Quisset Harbor in the latter part of September or early in October; these specimens weighing each $4\frac{1}{2}$ or 5 pounds. The largest Drum recorded was taken at St. Augustine Fla., and weighed 146 pounds. The large fish are not much valued for food, but small ones are said to be excellent.

129. Fresh-water Drum; White Perch (*Aplodinotus grunniens* Rafinesque).

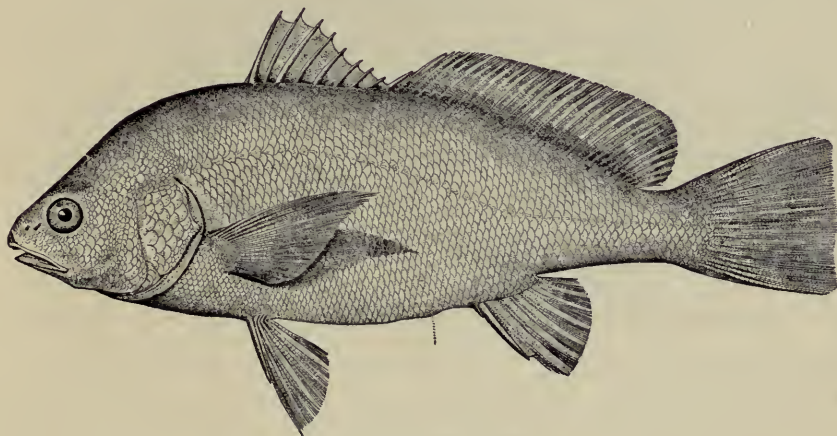
Aplodinotus grunniens JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1484, 1898, pl. CCXXVI, fig. 574, 1900.

Haploidonotus grunniens JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 567, 1883.

Corvina oscula DEKAY, N. Y. Fauna, Fishes, 73, pl. 21, fig. 63, 1842, Lakes Erie and Ontario.

The color is grayish, darker on the back; lower parts silvery. Young specimens have dark spots along the rows of scales, forming oblique lines.

The Fresh-water Drum has received a great number of common names. In the Ohio Valley and South it is known as the White Perch; in the Great Lakes region it is called Sheepshead or Fresh-water Drum on account of its resemblance to the Salt-water Drum. At Buffalo and Barcelona, New York, it is known as Sheepshead.



FRESH-WATER DRUM.

The name Crocus, used on lakes of Northern Indiana, is a corruption of Croaker, a name of a marine fish of the same family. In the Southern States the name Drum is generally applied to the species, and in addition the terms Thunder Pumper, Gaspergou and Jewel-head are used. Gaspergou is a term used in Arkansas, Louisiana and Texas. The names Drum, Croaker and Thunder Pumper have reference to certain sounds produced by the fish, either by means of its air bladder or by grinding together the large molar-like teeth in the pharynx. The name Jewel-head probably refers to the otoliths or ear bones, frequently called lucky stones, which are found in the skull of this species. In Texas, adjacent to Mexican territory, occurs the name Gaspagie, a variation of the name Gaspergou.

The Fresh-water Drum is widely distributed; it occurs in Lake Champlain and the entire Great Lakes region, the Ohio and Mississippi Valleys southward to Texas. The U. S. Fish Commission obtained a specimen at Point Breeze, N. Y., on Lake

Ontario. DeKay reported it as very common in Lake Erie, and called Sheepshead at Buffalo. At the time of his writing the fish was scarcely ever eaten. It is found principally in large streams and lakes, and rarely enters creeks and small rivers. In Western Texas the species is rare. In the wilds of Texas, New Mexico and Northern Mexico Mr. Turpe has found this fish in clear limestone streams emptying into the Rio Grande.

This species is usually found on the bottom, where it feeds chiefly on crustaceans and mollusks, and sometimes small fishes. It is especially fond of Crawfish and small shells, such as *Cyclas* and *Paludina*. Mr. Turpe mentions water plants as forming part of its food, and states that it will take a hook baited with worms or small Minnows.

The Fresh-water Drum grows to a length of 4 feet and a weight of 60 pounds, but the average market specimens rarely exceed 2 feet in length, and in many parts of the West much smaller ones are preferred. Nothing is recorded about the breeding habits of this species, and as to its edible qualities there is the greatest difference of opinion. Some writers claim that its flesh is tough and coarse, with a disagreeable odor, especially in the Great Lakes. Individuals from the Ohio River and from more southern streams are fairly good food fish, while in Texas Mr. Turpe considers it one of the most excellent of the fresh water fishes, comparing favorably with Black Bass. Mr. Ridgway, of the National Museum at Washington, pronounces the species from the Wabash River in Indiana a fine table fish, although, he says, other people there consider it inferior. Richardson described what is supposed to be a deformed specimen of this Drum under the name of *Malashegany*, which he had from Lake Huron. He described it as a firm, white, well-tasting fish, but never fat and requiring much boiling.

130. Bergall ; Cunner ; Chogset ; Nipper (*Tautogolabrus adspersus* Walbaum).

Tautoga cærulea MITCHILL, Rept. Fish. N. Y., 24, 1814, New York.

Labrus chogset MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 402, pl. 3, fig. 2, 1815, New York.

Labrus chogset fulva MITCHILL, l. c. 403, 1815, New York.

Crenolabrus uninotatus DEKAY, N. Y. Fauna, Fishes, 174, pl. 29, fig. 90, 1842.

Ctenolabrus adspersus JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 599, 1883.

Ctenolabrus adspersus BEAN, 19th Rept. Comm. Fish. N. Y., 251, pl. IV, fig. 6, 1890.

Tautogolabrus adspersus BEAN, Proc. U. S. Nat. Mus., 87, 1880; Bull. Am. Mus. Nat. Hist., IX, 368, 1897; 52d Ann. Rept. N. Y. State Mus., 107, 1900; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., II, 1577, 1896, pl. CCXXXVI, fig. 595, 1900.

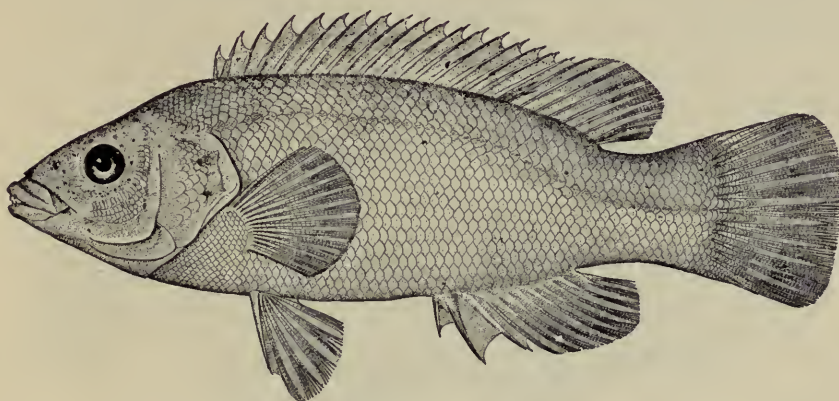
Color bluish or brownish, usually with a brassy luster on sides; head and back sometimes spotted with brassy; young with darker blotches and markings, and

often with a black blotch near the middle of the dorsal fin. Some individuals are yellowish and the young are often green.

The Cunner is known also as Chogset and Bergall (this changed to Bengal in Great Egg Harbor Bay, N. J.). Mitchill gives the name of Blue fish as in use in New York in 1815; Perch, Sea Perch and Blue Perch are New England names given for this fish. Names used with reference to its bait-stealing propensities are: Nipper and Bait-stealer.

The Cunner is common from Labrador to at least as far south as New Jersey.

The Bergall is found in Gravesend Bay throughout the year. In 1898 the writer found it in Peconic Bay and the adjacent Scallop Pond; south side of Great South Bay opposite Patchogue; Fire Island Inlet; Blue Point Cove and Duncan's Creek.



BERGALL.

In 1899 young examples were taken at Water Island ocean beach, June 6. In 1901 young of a yellow color and only $1\frac{3}{8}$ inches long, were seined in a creek near Fire Island Inlet August 15. Half-grown and adults were caught at a wreck on Tobey's Flat August 14, and at Smith's Point August 23.

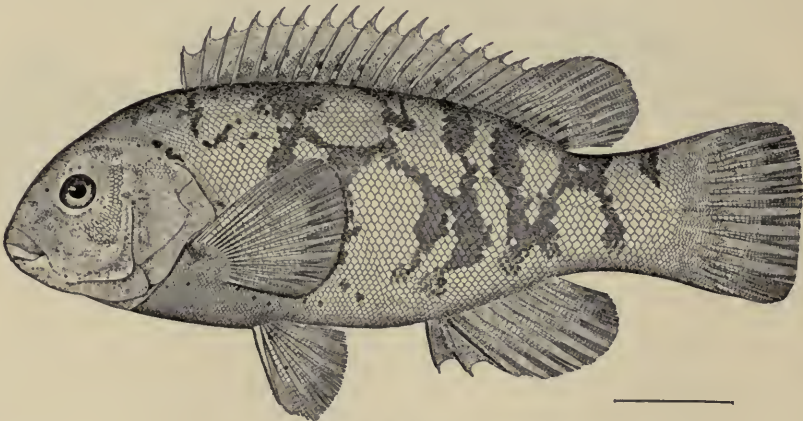
At Woods Hole, Mass., the Cunner is very abundant and remains during the entire year. Thousands perish from cold every winter. The fish spawns in June. The egg is about $\frac{1}{26}$ inch in diameter, buoyant, and has been hatched in the tidal cod-jar in five days in water of a mean temperature of 56° F. By August 1 the young an inch long are observed. Outside of Gayhead and Cuttyhunk the fish reaches a weight of $2\frac{1}{2}$ pounds, but the usual weight is from $\frac{1}{4}$ to $\frac{1}{2}$ pound. In February, 1901, thousands of Cunnners were killed by extreme cold at Wood's Hole.

The Cunner endures captivity very well, individuals having been kept three years or longer. The species is usually associated with the Tautog or Black fish; in many places it proves a great annoyance to fishermen. In some parts of New

England the fish is highly esteemed, but farther south it is not in high repute, the hard scales and stiff, sharp spines making it inconvenient to prepare for cooking.

Dr. Mitchill describes a yellow variety of the Cunner, and DeKay has considered the young, which has a black spot on the exterior portion of the dorsal fin, as a distinct species, named by him the Spotted Bergall.

The young vary greatly in color. We have seen some dull brown, others that were yellowish, and still others of a bright green. Dusky bands are characteristic, also, of the young stages. Examples were taken at Blue Point Cove, and at Fire Island. The Cunner is a permanent resident, and does not retreat into deep water except in very cold weather. Its spawning takes place in June and July. The species is fished for with the hook, and is taken in nets, which are baited and set among the rocks. The catch of the Irish Cunner boats of Boston has been estimated at about 300,000 pounds annually.



BLACK FISH.

131. Black Fish ; Tautog (*Tautoga onitis* Linnæus).

Tautoga niger MITCHILL, Rept. Fish. N. Y., 23, 1814, New York.

Labrus tautoga MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 399, 1815, Long Island.

Tautoga americana DEKAY, N. Y. Fauna, Fishes, 175, pl. 14, fig. 39, 1842.

Tautoga onitis JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 600, 1883 ; BEAN, 19th Rept. Comm. Fish. N. Y., 252, pl. V, fig. 7, 1890 ; Bull. Am. Mus. Nat. Hist., IX, 368, 1897 ; 52d Ann. Rept. N. Y. State Mus., 107, 1900 ; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., II, 1578, 1896, pl. CCXXXVII, fig. 596, 1900.

Color blackish, greenish, frequently pale bluish or bluish black, with metallic reflections. Often with irregular bands of a deeper hue. Lips, lower jaw and abdomen lighter, sometimes pale, sprinkled with black points, and sometimes of the same color as the rest of the body. Eye greenish.

This is better known in New York as the Black fish; farther south it is styled Chub or Salt-water Chub, Moll, Will, George and Oyster fish. Mitchill gives the name Tautog as of Mohegan origin. He publishes for the species the names Toad, Black fish and Runner. The Mohegan name Tautog, according to DeKay, is said to mean black. The fish is found from Nova Scotia to Virginia. It occurs in all parts of Great South Bay visited by us. Some of the localities at which it was taken are the following: Blue Point Cove and Life Saving Station, Great River Beach and Fire Island. The name used at Patchogue is Black fish. We saw a few Tautog among the fishes caught in a trap at Islip, October 1, 1890. In 1898 specimens were obtained in Peconic Bay, at Blue Point Cove, Islip, Nichols's Point and Fire Island Inlet; young individuals were taken July 29, August 25, September 1 and 16. Following is a list of localities in which the Tautog was sparingly taken in Great South Bay in 1901: Clam Pond Cove, July 19; Fire Island Inlet, August 15; Cherry Grove, August 17; Smith's Point, August 23; Mouth Swan River, September 25; Off Widow's Creek (young), September 28; Off Swan River (young), October 8 and October 11.

Dr. Mitchill gives a most entertaining account of the habits and mode of capture of this well-known species. At the time of his writing, in 1814, the price varied from 8 to 12 cents a pound.

132. Spade Fish; Triple Tail; Angel Fish (*Chætodipterus faber* Broussonet).

Chætodon oviformis MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 247, pl. V, fig. 4, 1815, New York.

Ephippus gigas DEKAY, N. Y. Fauna, Fishes, 99, pl. 23, fig. 71, 1842, New York.

Ephippus faber DEKAY, N. Y. Fauna, Fishes, 97, pl. 23, fig. 68, 1842.

Chætodipterus faber JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 613, 1883; BEAN, 19th Rept. Comm. Fish. N. Y. 253, pl. VI, fig. 8, 1890; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., II, 1668, 1896; IV, pl. CCXLVII, fig. 619, 1900.

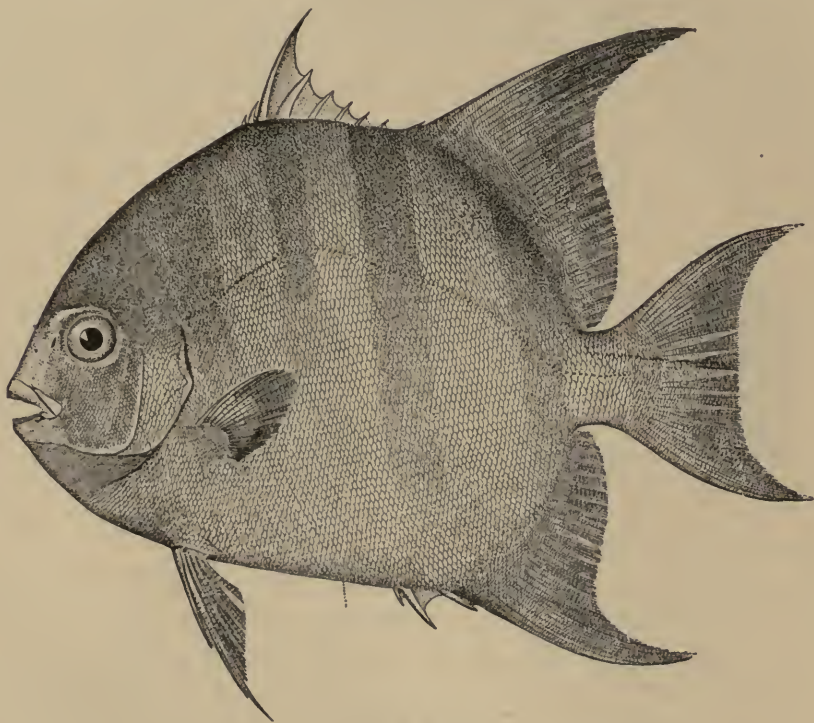
Grayish; a dusky band across the eye to the throat; a second similar band, broader, beginning in front of the dorsal and extending across the base of the pectoral to the belly; a third band narrower, extending to the middle of the sides from the base of the fourth and fifth dorsal spines; a fourth broader band from the last dorsal spines to anal spines, the remaining bands alternately short and long; all of these bands growing obscure and disappearing with age; ventrals black.

The Moon fish is the Sheepshead *Chætodon* of Mitchill, and the Banded Ephippus of DeKay. Dr. Mitchill records it as taken at the east end of Long Island, July 27, 1815. DeKay, in his *New York Fauna*, has the following concern-

ing the species: "About twenty years since, they were caught here in seines in great numbers and exposed in the market for sale. Some of them were 18 inches long. Those described by Mitchill were captured in 1815 and 1817. The popular names of Three-tailed Sheepshead and Three-tailed Porgee were given them by the fishermen in allusion to their prolonged dorsal and anal fins . . . Schoepff states that it is called Angel fish in South Carolina."

The species is called Spade fish in the States bordering the Gulf of Mexico.

The Moon fish has occasionally been taken as far north as Cape Cod. Dr. Smith records it as a very rare straggler in Vineyard Sound, Mass. A specimen was



SPADE FISH.

obtained in 1889, and three have been observed since. All were taken in traps at Menemsha in August and September. The fish were uniform in size and about 16 to 18 inches long. The species reaches a length of 2 to 3 feet. Southward it is recorded as far as Guatemala. It occurs in the West Indies. In Chesapeake Bay it is moderately common.

As a food fish this species is highly prized by those who are familiar with its qualities.

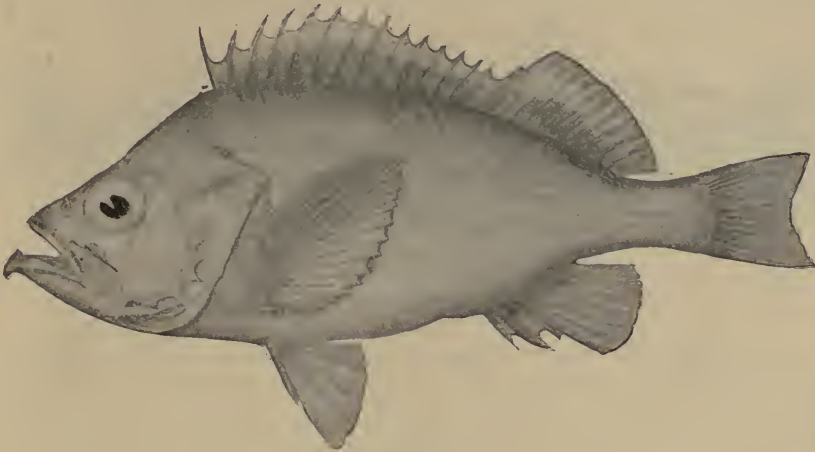
133. Rosefish ; Norway Haddock (*Sebastes marinus* Linnæus).

Sebastes norvegicus DEKAY, N. Y. Fauna, Fishes, 60, pl. 4, fig. 11, 1842, off New York in deep water ; STORER, Hist. Fish. Mass., 38, pl. VII, fig. 1, 1867.

Sebastes marinus GOODE & BEAN, Oceanic Ichth., 260, pl. LXIX, fig. 248, 1896 ; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., 1760, 1898, pl. CCLXVIII, fig. 653, 1900.

Orange red, nearly uniform, sometimes a dusky opercular blotch, and about five vague dusky bars on back. Peritoneum brownish.

The Rosefish is abundant at the hundred-fathoms line off the south coast of New England, and has been found in depths of 180 fathoms. It breeds abundantly in late summer at these depths, and there is no reason to believe that the young rise



ROSEFISH.

to the surface. The fry were caught by the bushel in the trawl net of the U. S. Fish Commission steamer *Fish Hawk*.

The species was originally described from Norway by Linnæus. Cuvier had specimens from Miquelon, Newfoundland. Day mentions a number of localities of its capture about the British Isles, but it is rare south of Faroe Islands. It occurs on the southwest coast of Spitzbergen, and on the Norwegian coast it is found everywhere from Christiana around to the Varanger-Fiord. It also occurs in Greenland, and from Labrador, as a shore form, as far south as Cape Cod, and in deeper water as far south as New Jersey.

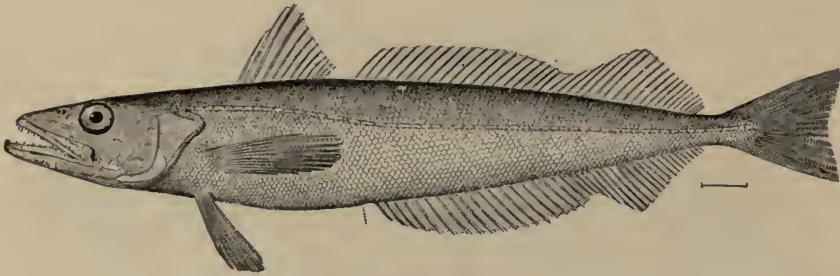
In the Woods Hole region it was taken on the shore on December 20, 1895, in Great Harbor. Seven or eight specimens, 3 inches long, were found in a hole on a flat, where they had been left by the tide ; four or five of these had been stranded and were dead ; the others were alive when captured. Fishermen claim that they

sometimes catch these fish in traps very late in fall at Provincetown. (After Smith.)

DeKay has the following remarks upon the fish :

This is a very rare fish in our waters. It is called by our fishermen Red Sea Perch, and they say it is only found in deep water. By the fishermen of Massachusetts it is known under the various names of Rosefish, Hemdurgon and Snapper. Fabricius states that it is a rather agreeable food, but meager. It feeds on Flounders and other fish, and takes the hook readily.

The species reaches the length of 2 feet ; it is frequently to be found in the Boston markets, and is seen occasionally in the markets of New York with the skin removed, on account of the hard scales.



WHITING.

134. Whiting ; Silver Hake (*Merlucius bilinearis* Mitchill).

Stomodon bilinearis MITCHILL, Rept. Fish. N. Y., 7, 1814.

Gadus merlucius MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 371, 1815.

Gadus albidus MITCHILL, Jour. Ac. Nat. Sci. Phila., I, 409, 1817.

Merlucius albidus DEKAY, N. Y. Fauna, Fish., 280, pl. 46, fig. 148, 1842.

Merlucius bilinearis BEAN, 19th Rept. Comm. Fish. N. Y., 249, pl. IV, fig. 5, 1890; GOODE & BEAN, Oceanic Ichth., 386, fig. 330, 1896; H. M. SMITH, Bull. U. S. F. C., 1897, 107, 1898; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., III, 2530, 1898; BEAN, 52d Ann. Rept. N. Y. State Mus., 109, 1900.

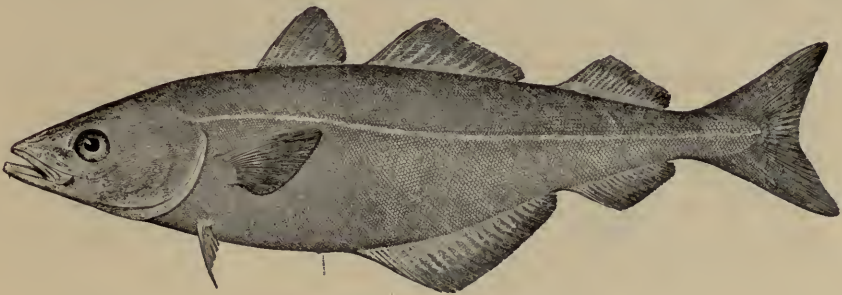
Grayish, darker above, dull silvery below ; axil and edge of pectoral somewhat blackish ; inside of opercle dusky silvery ; inside of mouth dusky bluish ; peritoneum nearly black.

The Whiting is known by the additional names of Hake and Silver Hake. Mitchill describes it as the Hake, *Gadus merlucius*. He states that it is caught with the other Cod. DeKay called it the American Hake. He styles it a rare fish in the waters of New York, and, when caught, always associated with the common Cod. The specimen described by DeKay was taken in November off Sandy Hook. In

his *New York Fauna*, he mentions Mitchill's description of a specimen which measured 21 inches in length.

The Whiting ranges from Labrador to Virginia. Young examples have been found even farther south in very deep water. This fish occurs in Gravesend Bay in spring and fall. In Great South Bay no individuals were seen by the writer during the summer, but an individual was obtained late in the fall by Capt. Thurber. October 28, 1898, several examples were received from the Atlantic, off Southampton.

According to Dr. Smith, the species is abundant every fall at Woods Hole, Mass., and some years it is common in summer. The fish swims close to the shore, and is caught in considerable numbers at Buzzards Bay at night with spears. Large individuals weighing 5 or 6 pounds are caught in traps. The young, measuring $2\frac{1}{2}$ to 3 inches long, are seined in the fall about Woods Hole. The names in use for the fish



POLLACK.

in that locality are Silver Hake, Whiting, and Frostfish. In Massachusetts Bay the Whiting is a frequent visitor to the shores and is probably a resident of the middle depths. The young are frequently trawled in deep water.

135. Pollack (*Pollachius virens* Linnæus).

Gadus purpureus MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 370, 1815.

Merlangus purpureus DEKAY, N. Y. Fauna, Fish., 286, pl. 45, fig. 147, 1842.

Merlangus carbonarius DEKAY, N. Y. Fauna, Fish., 287, pl. 45, fig. 144, 1842.

Merlangus leptocephalus DEKAY, op. cit. 288, pl. 45, fig. 146, Long Island.

Pollachius virens BEAN, Bull. Am. Mus. Nat. Hist., IX, 371, 1897; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., III, 2534, 1898; IV, pl. CCCLIX, fig. 886, 1900.

Greenish brown above; sides and below somewhat silvery; lateral line pale; fins mostly pale, sometimes a black spot on the axil.

The Pollack is a native of the North Atlantic. It is common northward on both coasts, and extends south to France and New Jersey. Mitchill described the fish under the name of the New York Pollack. DeKay mentions it under several

names, the New York Pollack, the Coalfish, and the Green Pollack. DeKay says the fish is taken with the common Cod, but is by no means common on the coast of New York. He saw a specimen weighing 17 pounds, and measuring 38 inches in length. In another description he states that the Coalfish is often taken off the harbor of New York in company with the Cod, and is known as Pollack and Black Pollack. The third form under which the fish was known to DeKay was described by him from a specimen captured by hook out of a large school in Long Island Sound. The Pollack enters Gravesend Bay in the fall. In captivity it is a ravenous feeder. It requires cold water and will not endure high temperatures.

DeKay states that the fish flipped in the same manner as the Menhaden, and was at first supposed to be of that species. The school seemed to be very timid, for, on a very slight noise in the boat, they all disappeared.

Dr. Smith states that adult Pollack appear in Vineyard Sound, Great Harbor, Woods Hole, Mass., in May, following the run of Cod. They depart when the temperature of the water reaches 60° or 65°. In April there is a run of Pollack measuring from 1 to 1½ inches long. By June, when these fish leave, they have reached a length of 4 inches. In fall there is a small run of Pollack 7 or 8 inches long. The average weight of adults in that locality is about 10 pounds, the largest one seined having weighed 14 pounds. In Massachusetts Bay this is an extremely abundant species, and constitutes an important food resource.

136. Tomcod ; Frostfish (*Microgadus tomcod* Walbaum).

Gadus tomcodus MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 368, 1815.

Cadus pruinosis MITCHILL, Rept. Fish. N. Y., 4, 1814.

Morrhua pruinosa DEKAY, N. Y. Fauna, Fish., 278, pl. 44, fig. 142, 1842.

Microgadus tomcodus BEAN, 19th Rept. Comm. Fish. N. Y., 248, pl. 111, fig. 3, 1890.

Microgadus tomcod BEAN, Bull. Am. Mus. Nat. Hist., IX, 371, 1897; MEARN, Bull. Am. Mus. Nat. Hist., X, 322, 1898; EUGENE SMITH, Proc. Linn. Soc. N. Y., 1897, 40, 1898; H. M. SMITH, Bull. U. S. F. C., 1897, 107, 1898; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., III, 2540, 1898; IV, pl. CCCLX, fig. 890, 1900; BEAN, 52d Ann. Rept. N. Y. State Mus., 109, 1900.

Color olive brown with reticulations and blotches of darker; sides and back profusely covered with dark punctulations; under parts lighter; dorsal, caudal and anal fins with dark blotches; pectorals and ventrals dusky.

This fish is very generally known in New York waters under the name of Frostfish. It ranges from Nova Scotia to Virginia, and is excessively common in shallow bays in cold weather. The name Frostfish is derived from the fact that it appears

after frosts have set in. The species ascends fresh-water rivers far above the limits of tide, and may be transferred suddenly from salt water to fresh without inconvenience. It spawns in the early part of winter, and is present at this time in such large numbers as to make its capture with dip nets comparatively easy. The Frostfish is the commonest member of the Cod family in New York waters. Its size is small, but, from the fact that it occurs in such abundance, it is an important market species. It is subject to great variations in color; Dr. Mitchill enumerates among its varieties five forms: the Brown, Yellow, Yellowish White, Mixed Tomcod and the Frostfish. DeKay has published the statement that he has known the Frostfish to be taken out of the water along the shores of Long Island in great numbers with a common garden hoe. He was informed that the species occasionally ascends the Hudson as far as Albany. In Great South Bay we found large numbers of Tomcod,



TOMCOD.

which were covered with a lernæan parasite. The same thing has been observed frequently at Woods Hole, Mass., and other northern localities. We found the species in nearly all parts of the bay late in September in moderate numbers, and more plentiful at Fire Island October 1.

July 29, 1898, a few young Tomcod were seined in Peconic Bay, near Southampton. In Gravesend Bay the fish is a fall and winter visitor. It does not live in captivity in summer. Dr. Mearns has found this fish in the Hudson River, where it is usually called Frostfish by the fishermen, who catch many of them in their fyke and ice nets during fall and winter. It bites readily and is esteemed as an article of food. Dr. Mearns has found it during the entire year, and in August has found young Tomcod fully an inch or two in length. He states that this fish is very often found in eel grass along shore, half dead, floating on the surface, but able to swim a little. Mr. Eugene Smith says that the Tomcod runs up stream into nearly pure fresh water in the vicinity of New York City. At Woods Hole, Mass., it is abundant in winter, coming about October 1 and remaining till May 1. It

spawns in December. In Massachusetts it is a resident species, entering brackish waters; it is common about the wharves and bridges in summer and is taken with nets and hooks in winter, in company with the Smelt.

The Tomcod reaches the length of about 10 inches. It is an important food fish and its eggs have been hatched artificially by the New York Forest, Fish and Game Commission in large numbers.

137. Cod (*Gadus morrhua* Linnæus).

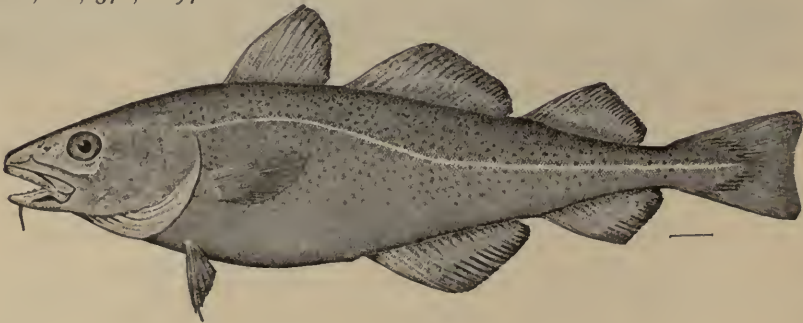
Gadus callarias MITCHILL, Rept. Fish. N. Y., 5, 1814; Trans. Lit. & Phil. Soc. N. Y., I, 367, 1815; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., III, 2541, 1898; IV, pl. CCCI.XI, fig. 891, 1900.

Gadus arenosus and *rupestris* MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 368, 1815.

Morrhua americana DEKAY, N. Y. Fauna, Fish., 274, pl. 44, fig. 140, 1842.

Gadus morhua MITCHILL, Rept. Fish. N. Y., 6, 1814.

Gadus morrhua GÜNTHER, Cat. Fish. Brit. Mus., IV, 328, 1862; GOODE & BEAN, Bull. Essex Inst., XI, 8, 1879; Oceanic Ichth., 354, 1896; BEAN, Bull. Am. Mus. Nat. Hist., IX, 372, 1897.



COD.

Color olive or yellowish brown; numerous dark brown spots on the body; fins dark.

The Cod is an inhabitant of the North Atlantic and the North Pacific. It is a very important food fish and grows to a large size. Individuals weighing about 100 pounds have occasionally been taken. Mitchill has described this fish under several names—the Torsh, or Common Cod, or Rock Cod of New York. DeKay calls it the American Cod. In November, 1897, the Cod was abundant in Gravesend Bay. It thrives in captivity during the winter and spring, but cannot be kept during the warm months without cooling the water. In Vineyard Sound, according to Dr. Smith, the Cod appear about April 1 to about April 15, when the Dogfish drive them away. After the middle of October the Cod come again but in less numbers than in the spring, remaining till the first wintry weather. The fish spawns during

the late fall and winter. The young are first observed at Woods Hole about the first of April, when fish about 1 inch long are seined. Most of the young leave by June 15, having attained a length of from 3 to 4 inches. No Cod are seen between small fish of that size and fish weighing from $1\frac{1}{2}$ to 2 pounds, which are caught in traps in the spring. Off the coast of New England Cod are very abundant in the deep waters, and they come up to the shoals and near the shores to spawn, from November about Cape Ann till February on Georges Banks.

138. Haddock (*Melanogrammus æglefinus* Linnæus).

Gadus æglefinus MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 370, 1815.

Morrhua æglefinus DEKAY, N. Y. Fauna, Fish., 279, pl. 43, fig. 138, 1842.

Melanogrammus æglefinus BEAN, Bull. Am. Mus. Nat. Hist., IX, 372, 1897; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., III, 2542, 1898; IV, pl. CCCLXI, fig. 892, 892a, 1900.



HADDOCK.

Dark gray above, whitish below; lateral line black; a large dark blotch above the pectorals; dorsals and caudal dusky.

Mitchill described the Haddock under the name *Gadus æglefinus*. DeKay also describes the fish and gives a figure of it in his *New York Fauna*. He states that it is nearly as common in the New York markets as the Cod, and during the summer it is even more abundant than the Cod.

The Haddock inhabits the North Atlantic on both coasts, ranging south to France and to North Carolina. Off Cape Hatteras it occurs in the deeper water. It is an important food fish, and reaches a moderately large size, attaining to a length of nearly 3 feet.

At Woods Hole, Mass., it was reported by Prof. Baird in 1871. Dr. Smith, however, says it is not found in Vineyard Sound or Buzzard's Bay, but is common 6 or 7 miles off Gay Head, and the ocean side of Martha's Vineyard. In Massachusetts Bay it is a common resident species.

139. Burbot ; Lawyer ; Ling (*Lota maculosa* LeSueur).

Gadus maculosus LESUEUR, Jour. Ac. Nat. Sci. Phila., I, 83, 1817, Lake Erie.

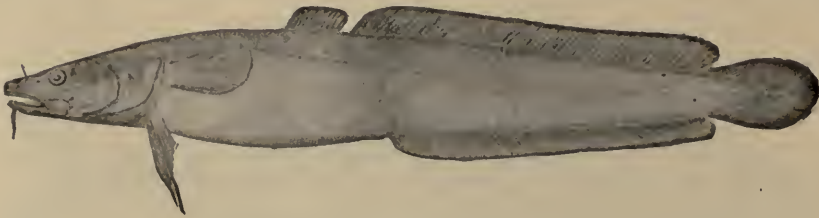
Gadus lacustris MITCHILL, Am. Month. Mag., II, 244, February, 1818.

Lota inornata DEKAY, N. Y. Fauna, Fish., 283, pl. 45, fig. 145, 1842, Hudson River.

Lota compressa DEKAY, op. cit. 285, pl. 78, figs. 244, 245, 1842.

Lota maculosa DEKAY, op. cit. 284, pl. 52, fig. 168, 1842; JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., —, 1883; MEEK, Ann. N. Y. Ac. Sci., IV, 315, 1888, Cayuga Lake; BEAN, Fishes Penna., 138, pl. 35, fig. 75, 1893; EVERMANN & KENDALL, Rept. U. S. F. C., 1894, 603, 1896; BEAN, Bull. Am. Mus. Nat. Hist., IX, 372, 1897, Canandaigua Lake; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., III, 2550, 1898; IV, pl. CCCLXIV, fig. 897, 1900.

The color is dark olivaceous, reticulated with blackish; the lower parts yellowish or dusky; the dorsal, anal and caudal fins with a narrow dark edge.



BURBOT.

The American Burbot was first described by LeSueur from Lake Erie in 1817, and also from Northampton, Conn., under a different name. This common fish has received a great many names, including the following: Marthy, Methy, Losh, Eelpout, Dogfish, Chub Eel, Ling, Lawyer, Lake Cusk, Fresh-water Cod, Aleby Trout and Mother-of-Eels.

The southern limit of this fish appears to be Kansas City, Mo.; according to Prof. Cope, it has been once taken in the Susquehanna near Muncy, Lycoming County; it is extremely common in the Great Lakes; westward it ranges to Montana and northward throughout British Columbia and Alaska to the Arctic Ocean; it is most abundant in the Great Lakes and lakes of New York, New England and New Brunswick; it abounds also in rivers and lakes of Alaska.

The Burbot was sent from Canandaigua Lake by Mr. James Annin, Jr., in November, 1897. It is hard to transport and still harder to keep alive in captivity, being especially liable to attacks of fungus.

Dr. W. M. Beauchamp, writing from Baldwinsville, N. Y., April 9, 1879, said that the Burbot is found in Seneca River and is abundant in Oneida Lake; that it is

caught with a hook and is seldom eaten, though there is a way of making it palatable.

According to Dr. Meek it is found rarely in Cayuga Lake.

The average length of this species in the Great Lakes region is about 2 feet; in Alaska, according to Dr. Dall, it reaches a length of 5 feet and occasionally weighs 60 pounds; the size of the fish depends chiefly on the amount of food accessible to it.

It is stated that the Burbot is usually found in deep water on mud bottom, except during the spawning season in March, when it frequents hard or rocky bottoms. The eggs are small and numerous, and are believed to be deposited in deep water; Dr. Dall estimates that some individuals contain several millions of eggs; in Alaska the eggs are of a creamy yellow color, and the fish are found full of spawn from November to January. From the observations mentioned it will be seen that the spawning period extends at least from November to March; according to Dr. Dall the males are usually much smaller than the females and have a smaller liver; in some males he found two or three gall bladders opening into a common duct, but he never observed this phenomenon in the female; the eggs are laid separate or loose on the bottom of the river. According to Barøn Cederström, a medium-sized female of the European Burbot, which is a near relative of the American species, contained about 160,000 eggs; in the European Burbot some eggs are clear, some yellowish and others almost colorless; the period of incubation occupies from three to four weeks; the eyes appear in 15 or 16 days; the embryos swim by quick movements of the pectorals, usually toward the surface of the water, whence they fall passively to the bottom.

The Burbot is extremely voracious, and feeds on bottom fishes and crustaceans. It destroys the Pike and such spiny fishes as the Yellow Perch and Sunfish. In Alaskan rivers it feeds on Whitefish, Lampreys and other species; large stones have sometimes been found in its stomach. Mr. Graham took a stone weighing a pound from the stomach of a Burbot.

In the Great Lakes region the Burbot is considered worthless for food; occasionally the livers are eaten; in Lake Winnepesaukee, when caught through the ice in winter, the fish is highly esteemed; in the fur countries the roe is an article of food; on the Yukon River the liver is eaten and the flesh is liked by some persons; in Montana the Burbot is in great demand for food; the quality of the flesh appears to depend chiefly on the nature of the habitat of the fish.

This is the only member of the Cod family permanently resident in the fresh waters of America.

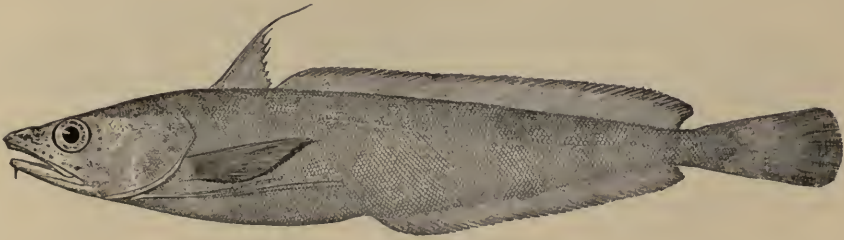
140. Hake ; White Hake (*Urophycis tenuis* Mitchill).

Gadus tenuis MITCHILL, Rept. Fish. N. Y., 5, 1814; Trans. Lit. & Phil. Soc. N. Y., I, 372, 1815, New York.

Phycis tenuis DEKAY, N. Y. Fauna, Fish. 293, 1842; BEAN, 19th Rept. Comm. Fish. N. Y., 248, pl. III, fig. 4. 1890; BEAN, Bull. Am. Mus. Nat. Hist., IX, 372, 1897; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., III, 2555, 1898; IV, pl. CCCLXV, fig. 901, 1900; BEAN, 52d Ann. Rept. N. Y. State Mus., 109, 1900.

Brownish, lighter and yellowish below; fins very dark. Distinguished from *P. chuss* chiefly by the smaller scales.

DeKay calls the Hake the American Codling, adopting Mitchill's common name for the species. He says it appears to feed chiefly on smaller crustacea; that it is very abundant at some seasons, but most abundant in the early part of autumn; and varies in weight from 3 pounds to 30 pounds. He states that it is called indis-



WHITE HAKE; COMMON HAKE.

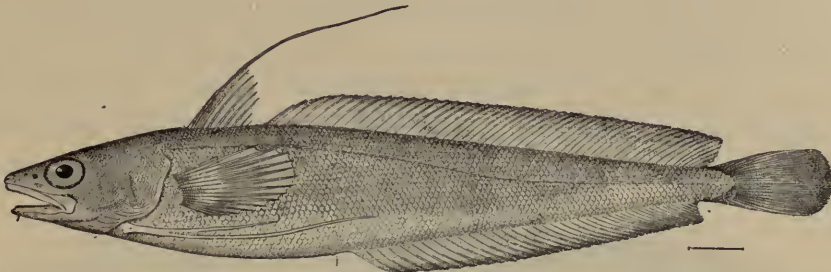
criminally Hake and Codling by New York fishermen. Small individuals were seined in Mecox Bay August 2, 1898, and a very young example was received from Southampton September 11. This was caught in the Atlantic. In Great South Bay small examples were found sparingly at Blue Point Cove and Fire Island late in September.

The Hake, according to Dr. Smith, is known also as White Hake and Squirrel Hake in the vicinity of Woods Hole, Mass. Fish weighing 1 to 1½ pounds are abundant there in November, when a great many of them enter Eel Pond. Young fish 1 inch long and upward associate with Pollack in spring and are also found throughout the summer in considerable numbers. They are also obtained in summer at the surface, under gulf weed and eel grass.

As a rule the Common Hake will not live in water of a temperature above 60° F., but one individual survived the summer temperature in 1897, and became plump and sleek after the arrival of cold weather. In summer it was much emaciated, and suffered greatly from fungus attacks.

It is abundant on our shores from Labrador to Virginia, and its young are among the commonest of the surface fishes in our bays and sounds, during the summer months. The Hake reaches a weight of 40 pounds, but in the markets the average weight is only about 10 pounds. The species frequents muddy bottoms and is local in its habits. Its food consists of crabs and other crustaceans, besides small fishes.

The chief fishery for Hake takes place in the fall and winter months, and they will take the hook at night as well as during the day. Trawl lines are the usual implements of capture.



SQUIRREL HAKE.

141. Squirrel Hake (*Europhycis chuss* Walbaum).

Gadus longipes MITCHILL, Rept. Fish. N. Y., 5, 1814; Trans. Lit. & Phil. Soc. N. Y., I, 372, pl. I, fig. 4, 1815, New York.

Phycis chuss BEAN, Bull. Am. Mus. Nat. Hist., IX, 372, 1897.

Urophycis chuss JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., III, 2555, 1898; IV, pl. CCCLXV, fig. 902, 1900.

Brownish above, sides lighter and tinged with yellowish; thickly punctulate with darker; below pale; inside of mouth white; vertical fins somewhat dusky; anal fin margined with pale; lateral line not dark.

According to Jordan and Evermann, this fish is sometimes called Codling. It inhabits the Atlantic coast from the Gulf of St. Lawrence to Virginia, being very common northward. It is sometimes found in waters as deep as 300 fathoms. The Squirrel Hake occurs occasionally in Gravesend Bay; it lives usually in the deep water off shore.

At Woods Hole, Mass., according to Dr. Smith, it is abundant in May and June, and in October and November. It fills the traps and causes the fishermen much annoyance, as they cannot sell the fish. Its weight there is from 2 to 5 pounds. In Massachusetts Bay it is less abundant than the Common Hake. It was described and figured by Storer in 1867, under the name *Phycis filamentosus*.

142. Cusk (*Brosme brosme* Müller).

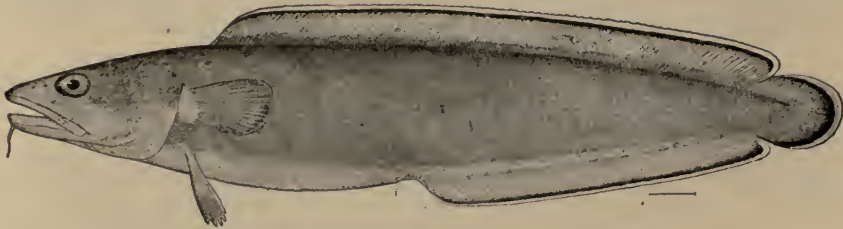
Brosmius vulgaris? DEKAY, N. Y. Fauna, Fish, 289, pl. 44, fig. 143, 1842.

Brosmius brosme GOODE & BEAN, Oceanic Ichth., 385, fig. 329, 1896.

Brosme brosme JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., III, 2561, 1898.

Color, brownish above, the sides yellowish, sometimes mottled with brown; young uniform dark slate, or with transverse yellow bands; vertical fins bordered with blackish, and with a white edge.

The Cusk is described and figured by DeKay, but he did not see the fish and copied his information from Storer and others. Storer mentions a specimen weighing 20 pounds, but the fish grows even larger. It inhabits the North Atlantic, ranging southward to New Jersey and Denmark. It is an important food fish.



CUSK.

According to Dr. Smith, it was formerly not uncommon in Vineyard Sound, and was caught with Cod in April and May. It has been very rare for more than 20 years, though a few are still taken in April. The average weight of individuals in those waters is 5 pounds, and the maximum weight from 12 to 13 pounds. It is known also as Ling. In Massachusetts Bay and vicinity the Cusk is a common resident on the inshore fishing grounds, where it occurs in great abundance, lurking among the stones, but it is soon caught up by the fishermen after the discovery of a new bank.

143. Halibut (*Hippoglossus hippoglossus* Linnæus).

Pleuronectes hippoglossus MITCHILL, Rept. Fish. N. Y., 10, 1814; Trans. Lit. & Phil. Soc. N. Y., I, 386, 1815.

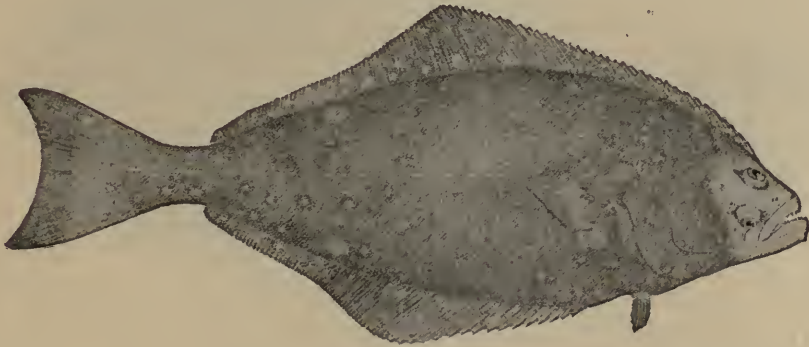
Hippoglossus vulgaris DEKAY, N. Y. Fauna, Fish., 294, pl. 49, fig. 157, 1842; STORER, Hist. Fish. Mass., 192, pl. XXX, fig. 1, 1867; GOODE, Fish. & Fish. Ind. U. S., I, 189, pl. 54, 1884.

Hippoglossus hippoglossus JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., III, 2611, 1898; IV, pl. CCCLXXI, fig. 918, 1900.

Color, nearly uniform dark brown; blind side white.

The Halibut lives in all northern seas, ranging southward to Sandy Hook, or beyond, and occasionally to the Farallones off San Francisco.

The Halibut was described by both Mitchill and DeKay under its present name. DeKay says that the capture of the Halibut on the shores of Nantucket at one time



HALIBUT.

afforded employment to 80 vessels of from 60 to 80 tons each. He says the fish is very voracious, swimming near the ground and devouring other flat fishes, as well as shells and crustaceans. It occurs on both shores of the Atlantic as also in the North Pacific, migrating south on the approach of spring and returning in June or July. An individual was found some years ago near Colonial Beach, in the Potomac River. The fish grows to the length of 8 feet or more, and the weight of several hundred pounds. It is a very valuable food fish. In the Pacific, according to Jordan and Evermann, it extends its range southward to the Farallones, off San Francisco.

The Halibut was formerly not very uncommon in Vineyard Sound, where it is now very rare. In 1872 and 1873 V. N. Edwards caught a number weighing 235 or 240 pounds while fishing for Cod. April 16, 1900, a Halibut weighing 100 pounds was caught off Block Island by Cod fishermen, and was taken to Newport. The fish

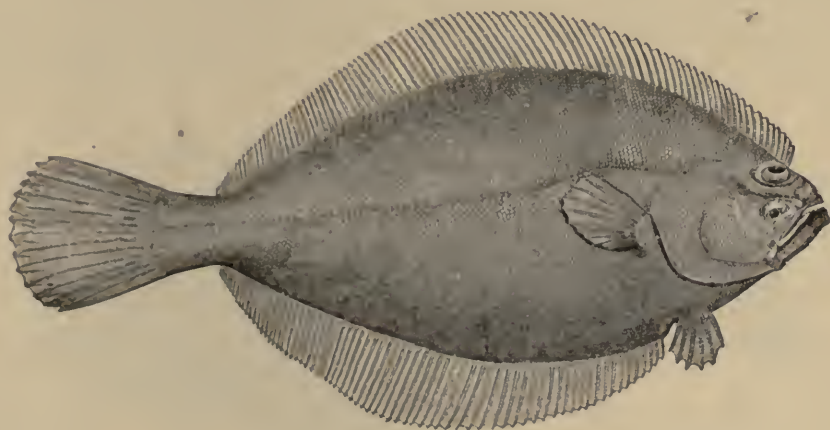
was very abundant at one time in Massachusetts Bay, but is now found chiefly in depths of 100 to 250 fathoms in the slopes of the outer banks. In August, 1878, a Halibut weighing over 200 pounds was caught in Gloucester Harbor.

144. **Rough Dab** (*Hippoglossoides platessoides* Fabricus).

Platessa dentata DEKAY, N. Y. Fauna, Fish., 298, 1842, New York markets.

Hippoglossoides platessoides GOODE, Fish & Fish. Ind. U. S., I, 197, pl. 55, 1884; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., III, 2614, 1898; IV, pl. CCCLXXII, fig. 919, 1900.

Reddish brown, nearly plain. North Atlantic; abundant northward on both coasts.



ROUGH DAB.

DeKay describes this Flounder under the name of the Toothed Flatfish. He said it was extremely common in New York markets, where it is called the Summer Flounder, and that it grows to the length of 25 inches. It is a rather common food fish of the deep waters northward on both sides of the North Atlantic, ranging habitually south to Cape Cod and the coasts of England and Scandinavia. At Woods Hole it is sometimes called Sand Dab and Rusty Flounder. Dr. Smith says it is not common there, but is found some years in winter in inshore waters adjacent to Woods Hole; specimens have been taken in February on lines. One year some were caught in a fyke net in Great Harbor. In Massachusetts Bay it is a common species in the deep waters, approaching the shores in winter.

145. Summer Flounder (*Paralichthys dentatus* Linnæus).

Pleuronectes dentatus MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 390, 1815.

Pleuronectes melanogaster MITCHILL, op. cit. 390, 1815, New York.

Platessa ocellaris DEKAY, N. Y. Fauna, Fish., 300, pl. 47, fig. 152, 1842.

Paralichthys dentatus GOODE, Fish & Fish. Ind. U. S., I, 178, 1884 (part); BEAN, 19th Rept. Comm. Fish. N. Y., 246, pl. II, fig. 2, 1890; Bull. Am. Mus. Nat. Hist., IX, 372, 1897; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., III, 2629, 1898; IV, pl. CCCLXXIII, fig. 922, 1900; BEAN, 52d Ann. Rept. N. Y. State Mus., 110, 1900.

Blackish olive, mottled and blotched with darker; in life light brown; adults with numerous small white spots on body and vertical fins; sometimes a series of larger white spots along bases of dorsal and anal; about 14 ocellated dark spots on sides, these sometimes inconspicuous, but always present; a series of four or five along dorsal base, and three or four along anal base, those of the two series opposite, and forming pairs; two pairs of smaller, less distinct spots midway between these basal series and lateral line anteriorly, with a small one on lateral line in the center between them; a large distinct spot on lateral line behind middle of straight portion; fins without the round dark blotches.

Is styled Flounder, or Summer Flounder, Turbot Flounder, Toothed Flatfish, Fluke, and, in Great South Bay, it shares the name Flatfish with the *Pseudopleuronectes americanus*. Brail and Puckermouth are names applied to it in Rhode Island. The name Fluke is the one most frequently used on Long Island.

The Fluke is a very abundant fish and is found on the eastern coast from about Cape Cod to the Gulf of Mexico. Centers of abundance are found on the Connecticut coast and on Long Island.

It is a summer visitor in Gravesend Bay, arriving in May or June and leaving when cold weather begins. It frequents the sandy flats for the purpose of feeding on little fishes, which it destroys in large numbers. A Fluke will often be found with eight or 10 little Blackfish in its stomach, and young Mackerel suffer greatly from its depredations. In Great South Bay this fish was found at Blue Point Cove and at Fire Island late in September, and was caught in traps at Islip, October 1, 1890.

Small Fluke were collected in Mecox Bay, Blue Point Cove and at Islip in August, 1898. Adults were obtained at Fire Island Inlet September 16 of that year, when they were abundant. In 1901 the fish were taken at Fire Island Inlet, Blue Point, and Smith's Point. August 1 they were feeding on small Menhaden. The next day they were seen in Wigo Inlet, and again chasing young Menhaden. On

that date more than half a barrel were caught in the inlet near buoy No. 2, with young Menhaden for bait. One of the Fluke disgorged a Sand Lance.

It feeds on small fishes, crustaceans, mollusks and occasionally on sand dollars, and one of its favorite foods is said to be the Squid. This fish is found generally in salt water, but frequently ascends fresh streams. Unlike the Flatfish, it moves off into deep water in winter, and may be found in summer near the shores. The Fluke has the same habit as the Flatfish, of burying itself in the sand when alarmed, or secreting itself from its prey. It is often found feeding about wharves, whose supports furnish it a suitable hiding place from which to dart on small fishes when they are congregated in schools. I have seen large individuals cautiously wriggling their way upward in the concealment of a wharf pile till within easy reach of a shoal of Silversides, when a sudden dart into the midst of the school would result in the capture of a fish, and the Flounder would leisurely sink to digest its victim and prepare for another onslaught. It has been known to reach a weight of 26 pounds. Dr. Goode has seen individuals measuring 3 feet in length. The fish is caught largely in weirs and traps. It is probable that more of them are taken in Vineyard Sound and in Rhode Island waters than on any other parts of our coast. The fishing season extends from May to October. They are carried alive in well-smacks to the markets. Menhaden is the bait principally used for the capture of the Fluke by hook and line.

146. Southern Flounder (*Paralichthys lethostigmus* Jordan & Gilbert).

Platessa oblonga DEKAY, N. Y. Fauna, Fish., 299, pl. 48, fig. 156, 1842, New York, not
Pleuronectes oblongus MITCHILL.

Paralichthys dentatus JORDAN & GILBERT, Bull. 16, U. S. Nat. Mus., 822, 1883.

Paralichthys lethostigmus JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., III, 2630, 1898.

Color dusky olive, with a few darker mottlings and spots.

This is the fish which was described by Jordan and Gilbert under the name of the Southern Flounder. It inhabits the South Atlantic and Gulf coast of the United States, ranging north to New York. DeKay described and figured it as the Oblong Flounder, which he says grows to the length of 15 to 20 inches and occasionally larger. He states that it is common along the sandy shores of New York, and is procured abundantly in the months of September and October; that it is excellent eating, and usually sells at from 6 cents to 8 cents a pound; that it is tenacious of life and can be preserved in good condition for a long period.

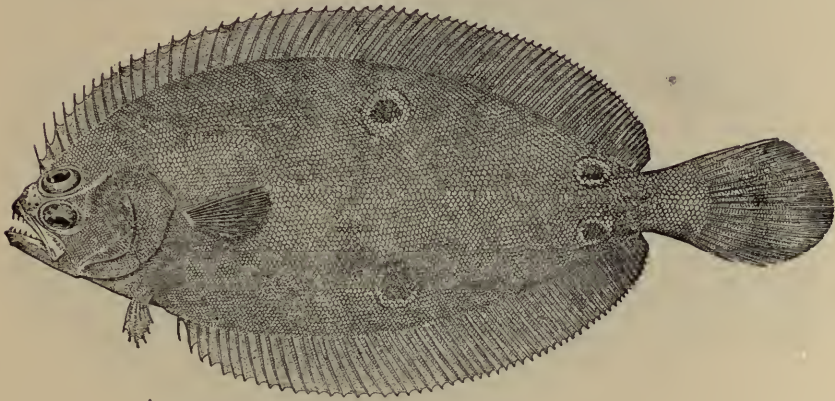
The Southern Flounder is very closely related to the Fluke or Summer Flounder. It is, however, always darker in color and almost uniform, while the Fluke is usually profusely spotted. The character by which it is best distinguished from the Fluke is the number of gill rakers. The Southern Flounder has only 12, of which 10 are below the angle of the first arch, while the Summer Flounder has from 20 to 24, of which from 15 to 18 are below the angle of the first arch.

147. Four-spotted Flounder (*Paralichthys oblongus* Mitchill).

Pleuronectes oblongus MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 391, 1815.

Platessa quadrocellata STORER, Hist. Fish. Mass., 203, pl. XXXI, fig. 3, 1867.

Paralichthys oblongus JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., III, 2632, 1898, IV, pl. CCCLXXIV, fig. 924, 1900.



FOUR-SPOTTED FLOUNDER.

Grayish, thickly mottled with darker and somewhat translucent; four large, horizontal oblong, black ocelli, each surrounded by a pinkish area, one just behind middle of body below the dorsal, one opposite this above anal; two similar smaller spots below last rays of dorsal and above last of anal. Atlantic coast, northward; not abundant.

The Four-spotted Flounder inhabits the coast of New England and New York. It is very common on the coast of New York and the neighboring islands. Mitchill described the fish in 1815. It grows to the length of about 14 inches. Its common name relates to the four large horizontal, oblong black ocelli. At Woods Hole, Mass., according to Dr. Smith, it is common in May and June, scarce at other times. It is most abundant about June, during the run of Scup.

Young fish are rarely observed, but in the fall of 1885 and 1886 large numbers two or three inches long were seen. The average length of adults there is 12

inches. The fish spawns in May, and its eggs have been experimentally hatched at Woods Hole. They are buoyant, $\frac{1}{26}$ of an inch in diameter, and hatch in eight days in water having a mean temperature of 51° to 54° F. In 1877 a single example was taken at the mouth of Salem Harbor by the U. S. Fish Commission.

148. Sand Dab (*Limanda ferruginea* Storer).

Platessa ferruginea DEKAY, N. Y. Fauna, Fish., 297, pl. 48, fig. 155, 1842.

Limanda ferruginea GOODE, Fish & Fish. Ind. U. S., I, pl. 49, 1884; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., III, 2644, 1898; IV, pl. CCCLXXVII, fig. 929, 1900.

Brownish olive, with numerous, irregular reddish spots; fins similarly marked; left side with caudal fin, caudal peduncle, and margins of dorsal and anal fins lemon yellow. Atlantic coast, chiefly northward.



SAND DAB.

This is also known as the Rusty Dab. It inhabits the coast of North America from Labrador to New York. DeKay calls it the Rusty Flatfish, which he says is a rare species, reported by the fishermen to occur only in deep water. The specimen described by him was 18 inches long. According to Dr. Smith, it is very common in Vineyard Sound and observed by him in water from 10 to 12 fathoms deep, where it may be found throughout the year. There is no fishery, but numbers are caught incidentally while bottom fishing for other species. In Great Harbor a few are taken in fyke nets, only in winter. The average length there is about 14 inches. In Massachusetts Bay it is a common resident species, inhabiting deep waters in summer, and approaching the shores in winter.

149. Flatfish; Winter Flounder (*Pseudopleuronectes americanus* Walbaum).

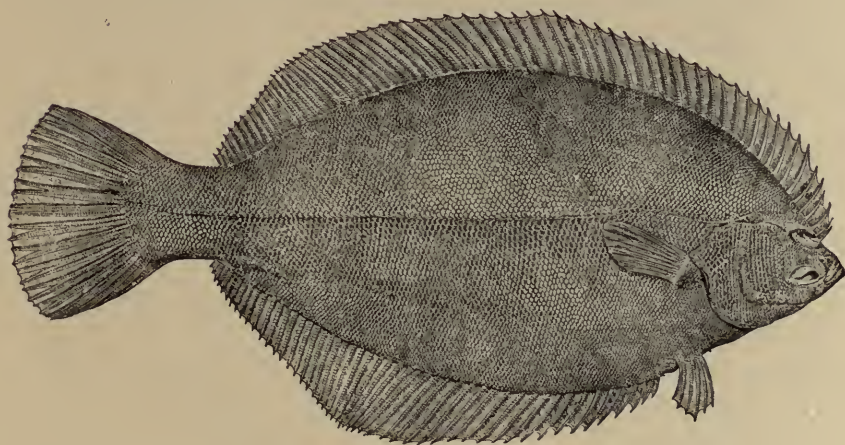
Pleuronectes planus MITCHILL, Trans. Lit. & Phil. Soc. N. Y., I, 387, 1815, New York.

Platessa plana DEKAY, N. Y. Fauna, Fish., 295, pl. 48, fig. 154, 1842; STORER, Hist. Fish.

Mass., 195, pl. XXX, fig. 2, 1867.

Platessa pusilla DEKAY, op. cit. 296, pl. 47, fig. 153, 1842, New York.

Pseudopleuronectes americanus GOODE, Fish & Fish. Ind. U. S., I, 182, pl. 44, 1884; BEAN, 19th Rept. Comm. Fish. N. Y., 245, pl. I, fig. 1, 1890; Bull. Am. Mus. Nat. Hist., IX, 373, 1897; H. M. SMITH, Bull. U. S. F. C., 1897, 108, 1898; JORDAN & EVERMANN, Bull. 47, U. S. Nat. Mus., III, 2647, 1898; IV, pl. CCCLXXIX, fig. 933, 1900; BEAN, 52d Ann. Rept. N. Y. State Mus., 110, 1900; SHERWOOD & EDWARDS, Bull. U. S. F. C., 1901, 31, 1901.



FLATFISH.

Dark rusty brown, spotted or nearly plain; young olive brown, more or less spotted and blotched with reddish.

The Common Flatfish is equally well known as Flounder or Winter Flounder. It ranges from the Chesapeake Bay to Labrador and appears to be alike abundant in both limits of its distribution. The Flatfish was found in Blue Point Cove, at Blue Point Life-saving Station, and on Fire Island Beach. It was moderately common in all of these localities. The species is a permanent resident of Great South Bay, but undergoes a partial hibernation in the mud in winter, and the adults in summer migrate into deeper and cooler water. A few individuals were observed by me in a fish pound at Islip, October 1, 1890.

Dr. Mitchill describes two color varieties of the Flatfish. One of these had a yellow margin on the lower side, surrounding the white of that side. This border was three-fourths of an inch wide and in striking contrast with the pearl of the con-

tiguous parts within it and the brown of the adjacent fins. The other variety, obtained April 9, 1815, has "a whiteness of the upper side nearly as clear as that of the nether surface over rather more than half its extent. The anterior part is blanched in this manner. The dorsal fin very sensibly partakes of the lighter hue; but its dark brown is tintured with yellow, especially on the rays. Something of the same kind, though less distinct, is observable on the ventral fins, and on about a dozen rays of the anal." The length of this individual was 5 inches and the breadth 3. Dr. DeKay obtained a specimen in April which was reversed and double. "Its color on both sides was uniform bronze, with a white patch on its right side near the chin, almost entirely denuded of scales; it had the singular protuberance over the eye, noticed by Dr. Mitchill in his *melanogaster*."

On the New Jersey coast young individuals are very common in summer, but the adults are rarely found except in the winter.

At Woods Hole, Mass., this is a very abundant permanent resident, frequenting muddy or grassy bottoms. The average weight of those taken in the immediate vicinity of the Fish Commission Station was only 1 pound, but larger fish are found in the deeper water of the sound and bay. In October fish averaging 2 pounds, and apparently migrating, are taken with lines in Vineyard Sound on sandy bottom.

In the markets this species is extremely common in the winter and spring months, and the flesh is delicious even when the eggs are nearly mature. It feeds on small shells, crabs and other invertebrates living in the mud. When at rest it partly submerges itself in the sand or mud, and changes its color to suit its surroundings.

In Long Island bays the Flatfish spawns from February to the end of March, and in July the young have attained to the length of half an inch. At Woods Hole, Mass., according to Dr. Smith, it spawns from February to April. On being transferred to tanks containing running water, many deposit their eggs during the night. The eggs are $\frac{1}{30}$ of an inch in diameter and very glutinous, sticking together in masses of various sizes. The average number to a fish is 500,000. March 6, 1897, a fish that weighed $3\frac{1}{2}$ pounds after spawning furnished 30 fluid ounces of eggs, numbering 1,462,000. The eggs hatch in 17 or 18 days, when the mean water temperature is 37° or 38° F.

